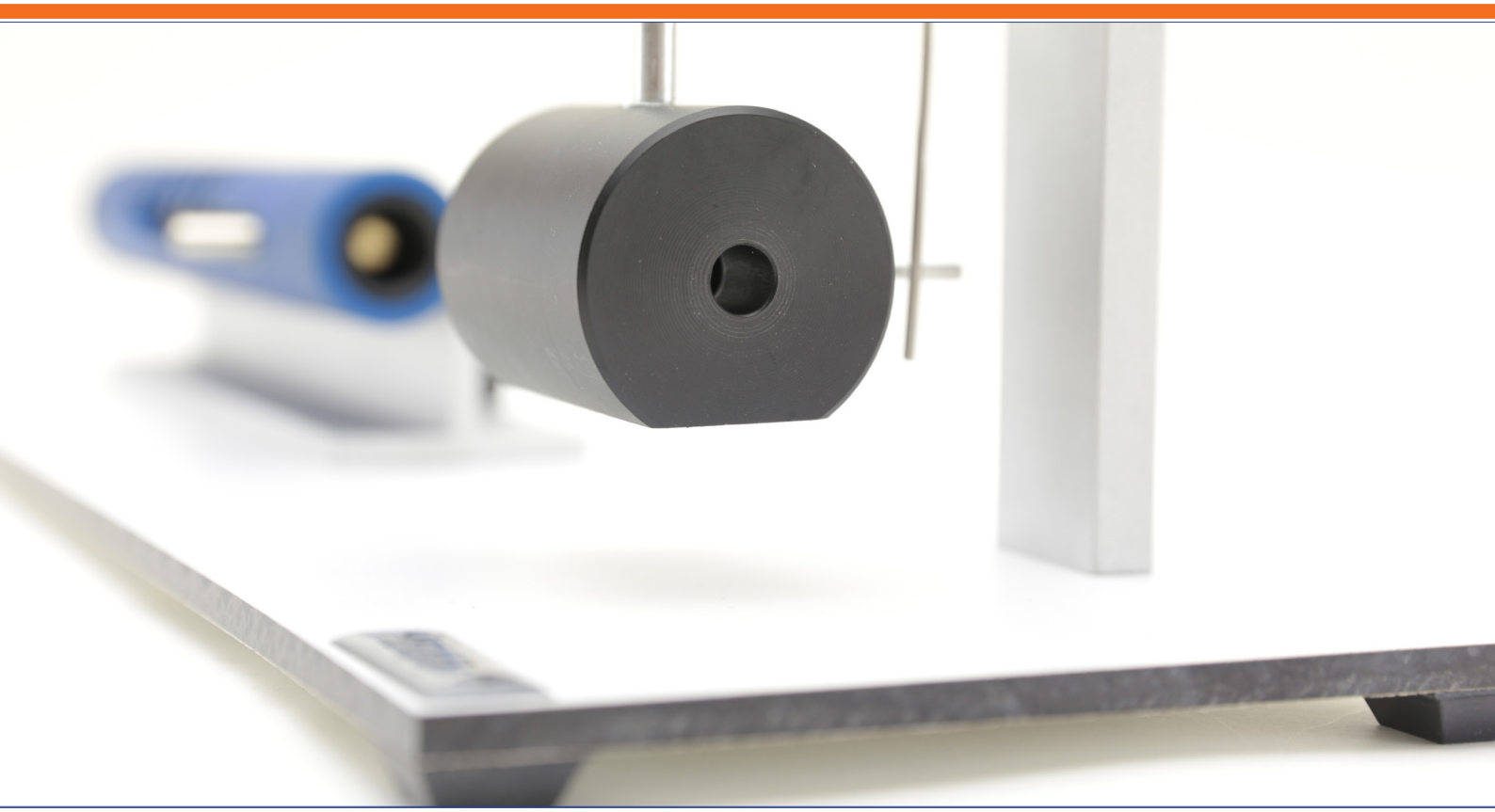
Index

Teaching guide in digital format

Minimum invoiced order: € 130,00 + VAT



Masses with double hook

8 masses: 1 g (1pc); 2 g (2pcs); 5 g (1pc); 10 g (1pc); 20 g (1pc); 50 g (1pc); 100 g (1pc) **1352**

10 masses 10 g **1398**

10 masses 25 g **1399**

10 masses 50 g **1066**

1352 - 1398 - 1399 - 1066

Slotted masses

9 masses 10g + holder 10g. **1309**

9 masses 20g + holder 20g. **1310**

9 masses 50g + holder 50g. **1311**

9 masses 100g + holder 100g. **1312**

9 masses: 1g (1pc), 2g (2pcs), 5g (1pc), 10g (1pc), 20g (1pc), 50g (1pc), 100 g (1pc), 200 g (1pc) + holder 50 g. **1353**

1309 - 1310 - 1311 - 1312 - 1353

Rod for lever with stand 1354

Supplied with rectangular base, metal rod, pivot, bosshead, and 2 slotted masses code 1310.

1354

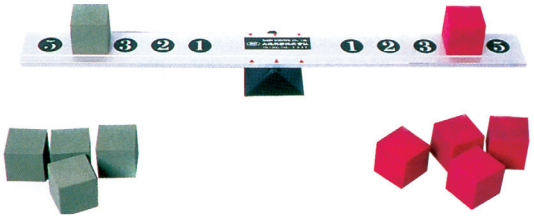
Rod for levers 1152

Aluminum rod, with holes and pivot. Length: 38 cm.

1152

Unequal-arms scale 1313

For experiments on the equilibrium of a lever. It is supplied with 10 masses.



1313

Aluminum pulleys

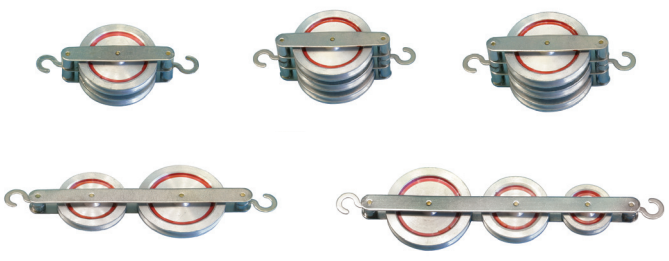
Simple pulley Ø50 mm **1058**

Parallel of two pulleys Ø50 mm **1059**

Parallel of three pulleys Ø50 mm **1060**

Series of two pulleys Ø40 - 50 mm **1061**

Series of three pulleys Ø30 - 40 - 50 mm **1064**



1058 - 1059 - 1060 - 1061 - 1064

Plastic pulleys

Simple pulley Ø50 mm **1227**

Parallel of two pulleys Ø50 mm **1160**

Parallel of three pulleys Ø50 mm **1266**

Series of two pulleys Ø 50 - 40 mm **1228**

Series of three pulleys Ø30 - 40 - 50 mm **1127**

Pulley Ø35 mm with perpendicular axes Ø6 mm **1009**

Pulley Ø50mm with longitudinal axes Ø8 mm **1157**

1227 - 1160 - 1266 - 1228 - 1127 - 1009 - 1157

Force Table 1166

It allows you to study vectorial forces composition.
Graduated metal disk, 400mm diameter. Height 500mm.

Equipment supplied

4 Pulleys	4 Slotted masses 50 g	
4 Masses holder 100 g	4 Slotted masses 20 g	4 String with rings
4 Slotted masses 100 g	4 Slotted masses 10 g	

1166

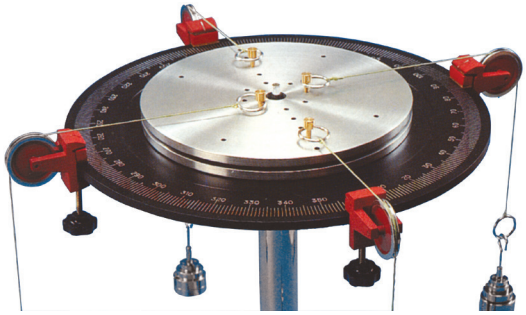
Spool of thread - 50 m 8153

Made of light, twisted nylon, it's thin and flexible.

8153

Disk of the momenta 1380

Accessory of our code 1166. It allows the study the equilibrium of the momenta.



1380

Equilibrium forces composition device 1032

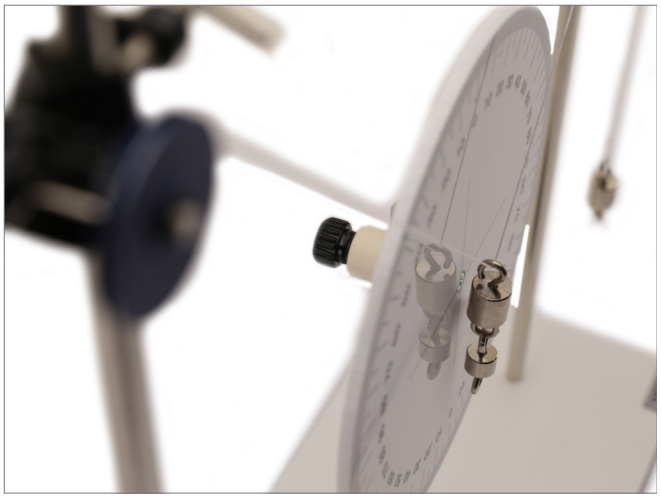
The equilibrium forces composition device allows the examination of the physics laws of concurrent forces composition - the parallelogram law and the parallel forces law.
Dimension: 45x17x60 cm.

Topics

- Forces composition
- Concurrent forces
- Parallel forces

Equipment supplied

1 String
1 Base with rod
2 S-shaped hooks
2 Double bossheads
2 Fixed pulleys
1 Rod with holes
6 10 g masses with double hook
6 25 g masses with double hook
1 200 mm diam. protractor
2 Threaded vertical rods with washers and screws
1 Transversal rod with handwheels
1 Rectangular base



1032

Levers and pulleys experiment kit 1341

12 performable experiments

The proposed experiments can be performed using the force sensor (not supplied) Cod. 12943-00.

Topics

- The spring scale
- How to measure a weight or a force
- Let's learn how to use forces in a wise way
- Equilibrium of a rod pivoted on its centre
- Simple machines
- Levers
- The fixed pulley
- The mobile pulley
- Simple hoist
- Pulleys in parallel
- Pulleys in series

Equipment supplied

1 Rod with hook
1 String
1 Folding metal rod 70 cm
1 Pivot with wing-nut
1 Tripod base
1 Bosshead 13 mm
1 10 masses 50g with 2 hooks
1 Lever rod
2 Pulleys in parallel
2 Simple pulleys
2 Pulleys in series
1 Spring scale 250 g
1 Box

1341

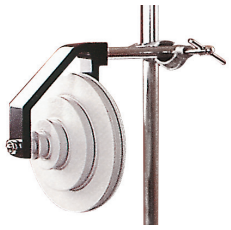
Momenta apparatus 1167

The Momenta apparatus is composed of an aluminium disk rotating around a central pivot.
Different masses can hanged up on the disk in different positions.
Disk diameter 25 cm.
Equipment supplied: 10 masses 10 g; 10 masses 25 g; 4 strings.

1167

Multiple pulley 1362

It is composed of a group of 4 coaxial and solidal pulleys,whose diameter is Ø 2, Ø 4, Ø 8 and Ø 12 cm. It is supplied with a support.
Rod and clamp are not included.



1362

Precision inclined plane 1103

A spring scale (1N/0,01N) and a protractor are included in this kit. Using these instruments you can directly read inclination and force's value.
Plane dimensions: 95 x 500 mm.

Equipment supplied

1 Spring scale 100 g
1 Glider
2 Masses 50 g
4 Masses 10 g
1 Inclined plane with protractor

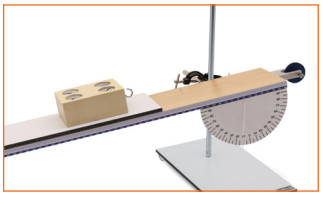
1103

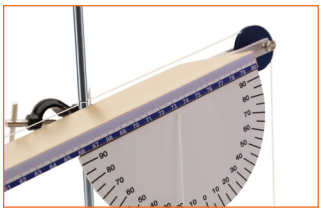
Friction inclined plane 1291

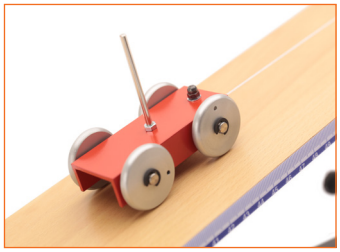
The Friction inclined plane apparatus enables investigation of the physics laws of equilibrium forces, the laws of sliding friction and also the determination of its coefficient. Plane dimension: 800 x 100mm.

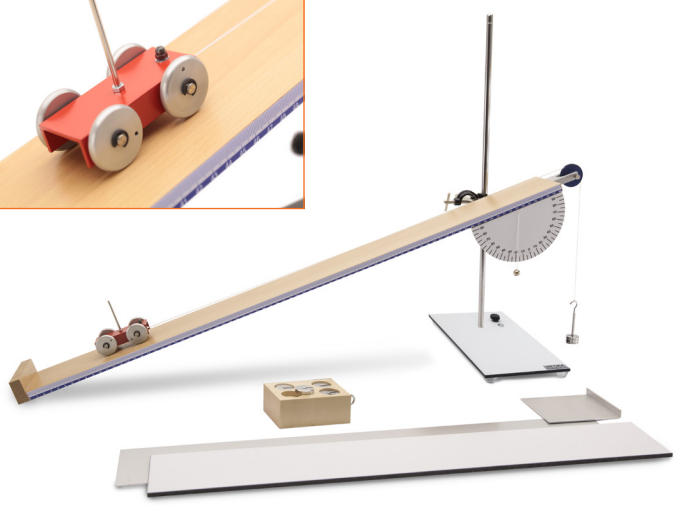
Equipment supplied

1 Metal rod 50 cm
1 String
1 Bosshead
1 Linear ruler
9 slotted masses 10g + holder 10g
9 slotted masses 20g + holder 20g
1 Base
1 Inclination protractor
1 Wooden plane with pulley
1 Aluminium plate
1 Fibreboard panel
1 Aluminium plane with angle
1 Low-friction glider
1 Wooden block









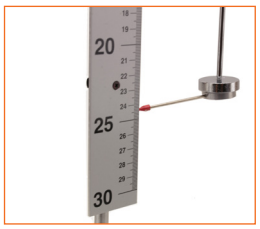
1291

Hooke's law apparatus 1111

It allows you to verify that, within specific limits, the lengthening of a spring is proportional to the intensity of the applied force. The graduated scale has 1 mm division and the perfectly balanced masses-holder has an index which can rotate to consent the perfect allignment with the graduated scale.

Equipment supplied

1 Rod with hook
1 Bosshead
1 Spring Ø 20 mm
1 Base for rod
1 Metric rod
4 Slotted masses 50 g
4 Slotted masses 10 g
1 Masses holder with position indicator
1 Spring Ø 10 mm; L = 75 mm
1 Spring Ø 10 mm; L = 60 mm
1 Spring Ø 10 mm; L = 50 mm
1 Spring Ø 20 mm; L = 60 mm
1 Linear rule



1111

Flexible parallelepiped 1077

It consists of an aluminium framework with flexible corners; in this way it mantains parallel bases as it undergoes deformation. By using the plumb-line it is possible to verify the equilibrium conditions of solid bodies standing on a plane.

1077

Instrument used to study equilibrium states 1078

The equilibrium forces of physics can be demonstrated by moving the two lateral masses in this device. The center of gravity of the system can be moved to different positions, demonstrating how the equilibrium depends on the position of the center of gravity with respect to the basement point.
Dimensions: 20x28 cm.

1078

Set of 5 springs with index 8179

Features:

1° K= 2,4 N/m;	capacity: 0,5N
2° K= 5 N/m;	capacity: 1N
3° K= 9,8 N/m;	capacity: 2N
4° K= 14,5 N/m;	capacity: 3N
5° K= 39,2 N/m;	capacity: 5N

8179

Bodies center of gravity 1195

Thanks to the plumb line, it is possible to determine the vertical passing through the suspension point. Repeating the experiment in several points you will find the center of gravity of the figures supplied.

1195

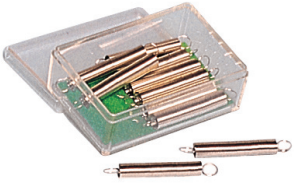
Set of 4 springs and 1 elastic band 8155

Suitable for perform experiments on Hooke's law and on elastic oscillations. Two of the springs have the same features in order to be used in series or in parallel.

8155

Set of 10 springs 8158

With the same elastic constant and same length.
Elasticity constant: K= 6,5 N/m.



8158

Equilibrium, forces, momenta and machines 1123

Set for experiments on solid statics. The proposed experiments can be performed using the force sensor (not supplied) Cod. 12943-00.

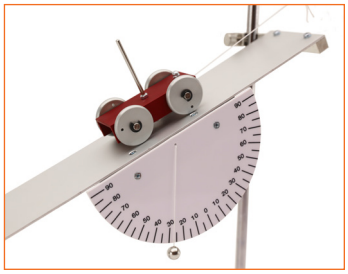
15 feasible experiments

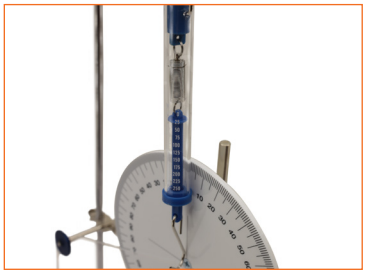
Topics

- Composition of concurrent forces
- Decomposition of a force
- Composition of parallel concording forces
- Composition of parallel discording forces
- The center of gravity
- Hooke's law
- Equilibrium of a bar
- Equilibrium of momenta
- Levers
- Fixed pulley
- Mobile pulley
- Simple hoist
- Hoist with a couple of pulleys in parallel
- Hoist with a couple of pulleys in series
- Inclined plane

Equipment supplied

4 Bosshead 6 mm
10 Modular metal rods 35 cm
2 Hooked rod
2 Spring
2 S shaped hook
3 Bosshead
3 Fixed pulley
1 Centre of gravity foil
1 Spiral spring
1 Linear ruler
1 Rod for levers with pin
2 Couple of pulleys in parallel
1 Glider
1 Mobile pulley
2 Couple of pulleys in series
1 Spring scale 250 g – 2.5 N
2 Series of 10 g masses
1 Series of 20 g masses
1 Momenta disc with pin
1 Metal rod 50 cm with reduction
1 Protractor with pin
1 Inclined plane with protractor
2 Bases for frame
1 Holder for frame





1123

Static kit for magnetic board 1328

Equipment to perforne experiments on solid statics.

Blackboard not included. We recommend the purchase of the code 1329.

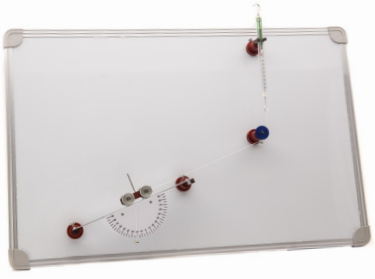
20 feasible experiments

Topics

- Composition of concurrent forces
- Composition of parallel forces
- Decomposition of a force
- Elastic forces
- Hooke's law
- The centre of gravity
- Equilibrium of a pivoted rod
- Equilibrium of momenta
- Levers
- Inclined plane
- The grazing friction
- Pulleys
- Pulleys in parallel
- Pulleys in series
- Combinations of simple machines

Equipment supplied

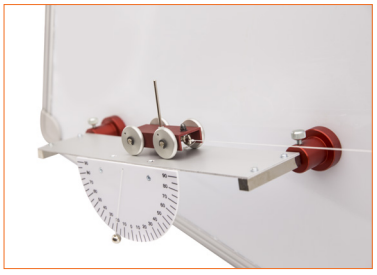
4 Magnetic holders
3 Rods with hook
2 Mobile pulleys
2 Serieas of slotted masses 10 g with holder
2 Slotted masses 50 g
1 Rod for levers with pivot
1 Spring with index
1 Moments' disk
2 pulleys in series
3 pulleys in series
1 Wooden block
2 Strings
1 "S"-shaped hook
1 Spring scale 200 g
2 Fixed pulleys
1 Protractor 360°
1 Slotted masses 20g with holder
1 Metal sheet for center of gravity
2 Triple pulleys in series
1 Linear ruler
1 Bosshead for spring scale
1 Inclined plane with protractor
1 Glider
1 Box



1328

Magnetic board with stand 1329

With white board surface in order to draw diagrams and write formulas.
It can be assembled on a table in vertical position.
Dimensions: 90x60 cm.
Ideal complement for the statics kit (code 1328).



1329

Galilean relativity

NEW

1842

Introduction:

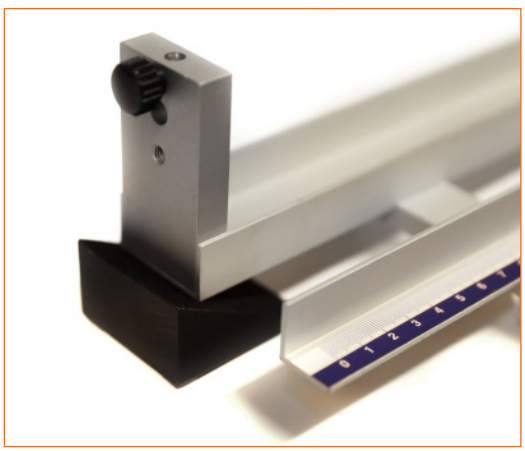
Physics is a science in continuous development, during its evolution many things have changed, such as the problems to be faced and the tools created to solve them.
One thing, however, has remained unchanged: the method of investigation based on experimentation, of which Galileo laid the foundations.
This didactic unit, through the execution of simple experiences, can help the teacher to demonstrate how Galileo's principle of relativity was used by Newton in formulating the laws of mechanics.

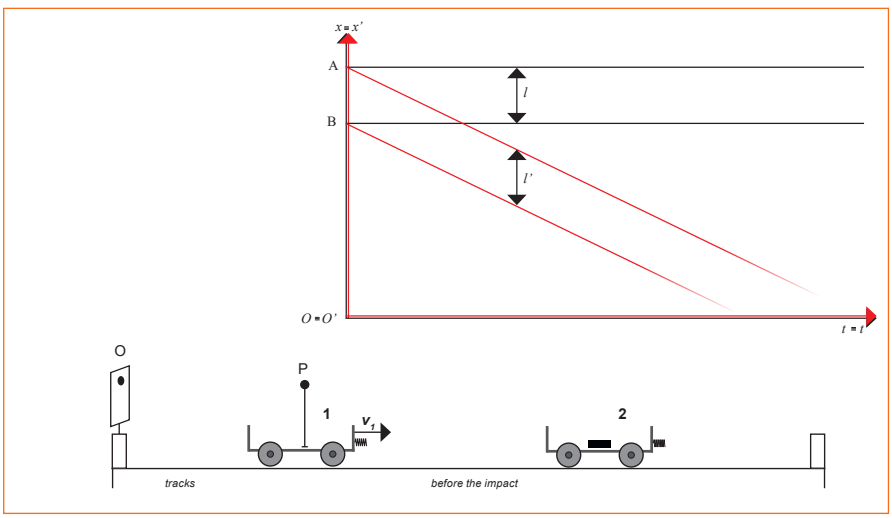
Topics

- When the reference changes
- Galileo's transformations
- The invariant quantities
- The position of an object
- The length of a segment
- The speed
- Acceleration
- The force
- The momentum
- Kinetic energy
- The invariance of mechanical laws
- The first law of dynamics
- The second law of dynamics
- The principle of conservation of momentum
- Conservation of momentum and Galileo's relativity
- The principle of conservation of kinetic energy
- Conservation of kinetic energy and Galileo's relativity
- Pendulum oscillations and Galileo's relativity
- Galileo's crisis of relativity

Equipment supplied

1 track	1 clamp
2 trolleys	1 ball with hook
1 rod with ball 1484	1 rod with hook
1 rod holder with ball	1 linear ruler
1 distance sensor	1 weight 5g with hook
1 skein of string	1 metal rod
1 wedge	1 pulley with rod
1 base	3 weights 10g





The principle of equivalence NEW 8124

Introduction:

Free fall is defined as the movement of an object when only the force of gravity acts on it.

A person who was in a spacecraft in an area of the universe in total absence of gravity would see all the objects around him floating.

If, however, without his knowing it, the rockets under the floor capable of accelerating the vehicle upwards were fired, the person would see the objects fall to the ground, as if the vehicle were in a gravitational field. With this didactic unit it is possible to verify the principle of equivalence between gravity and acceleration proposed by Einstein.

Topics

- The properties of matter
- Newton's first law
- Newton's second law
- The inertial references
- The principle of relativity in classical physics
- The force of gravity
- The free fall
- Inertial mass and gravitational mass
- That strange force of gravity
- Newton's Doubts
- The gravitational oscillator
- When a reference is not inertial; the apparent forces
- The lift
- Einstein's thought
- Equivalence between gravity and acceleration
- The principle of equivalence in general relativity
- Consequences of the principle of equivalence

Equipment supplied

1 Dynamometer 1N
1 Magnetic anchor
1 Rod with hook
1 Metal cylinder with hook 5g
1 Table vise
3 Metal rods
1 Support for vertical magnet
1 Support for horizontal magnet
1 Coil 400 turns
1 Coil 1600 turns
2 Core for threaded reel
2 Threaded disc
3 Electric cable 100 cm
1 graduated glass 250 cc
1 Transparent bottle with iron cap and float
1 Magnet
1 sheet of aluminum foil
1 Newton's tube
1 Hand pump
1 Support for dynamometer
1 Skeins of thread
1 Wooden ball with hook
1 PVC ball with hook
1 Aluminum ball with hook
1 Trolley
1 Metal cylinder with hooks 50g
1 Table vice with pulley

8124

The interactions in physics

NEW

1520

Introduction:

How is it possible that such small elements of matter can give rise to so many different phenomena and, above all, can form bodies that are extremely larger than themselves, such as gigantic planets and clusters of stars?

This question is answered in the fact that, as was previously stated, all particles have properties through which they interact.

This didactic unit allows to verify that there are no single forces as all the interactions satisfy the 3rd principle of dynamics.

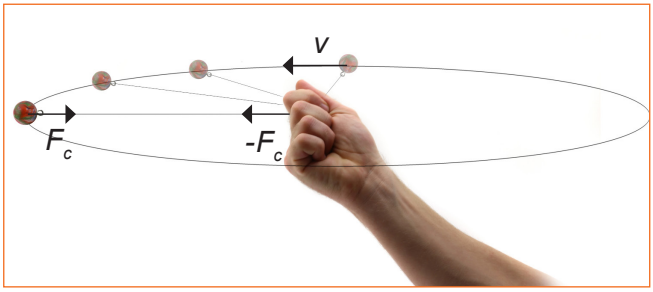
The proposed experiments can be performed using the force sensor (not supplied) Cod. 12943-00.

Topics

- Matter
- The interactions
- The first astronomical systems
- The Copernican system
- Kepler's laws
- The curvilinear motion
- The dynamics of planets with circular orbit
- The gravitational interaction
- The law of universal gravitation
- Electricity
- The electric charge
- The electrostatic interaction
- The electrical state of a body - the electroscope
- Coulomb's law
- The quantization of the electric charge
- Magnetism
- The magnetic poles
- The magnetic forces
- The magnetic interaction
- Electrostatics and magnetism - analogies
- The experience of oersted
- Faraday's experience
- The ampere experience - the electromagnetic interaction
- The unit of measurement of the intensity of electric current in the yes
- The atomic nucleus
- The weak interaction
- The strong interaction

Equipment supplied

1 Apparatus of the ellipse
1 Lanyard
1 rubber ball with hook
1 Dynamometer 2,5 N
1 Pair of cylinders
2 PVC rods
1 Set of five rods with support
2 cables of 100cm
2 Alligator clips
1 glass flask 250ml
1 Rod for electroscope
1 sheet of aluminum foil
1 Roll of adhesive tape
1 Linear magnet
1 Transparent plate
1 Iron filings
1 Teaspoon
1 Pair of magnetic needles
1 Compass
1 Apparatus of electromagnetic interactions
1 Electric cable 25cm
1 protractor
1 Pair of magnetic pendulums



1520

Introduction

The plane of the movement, code 8218, is also described in the section of the catalog dedicated to electromagnetism, since, in addition to allowing the study of linear motions, using RTL techniques, it allows a demonstration of Lenz's law on electromagnetism.
The didactic interest of the experiments that can be performed with this apparatus is manifold and in fact with it the student:
- becomes familiar with the dimensions that characterize the movement;
- learn to relate the distance-time graph with the velocity-time and acceleration-time graphs;
- can measure the intensity of friction forces and the acceleration of gravity;
- can study how potential and kinetic energy vary as a function of time and distance.

Motion plane

NEW

8218

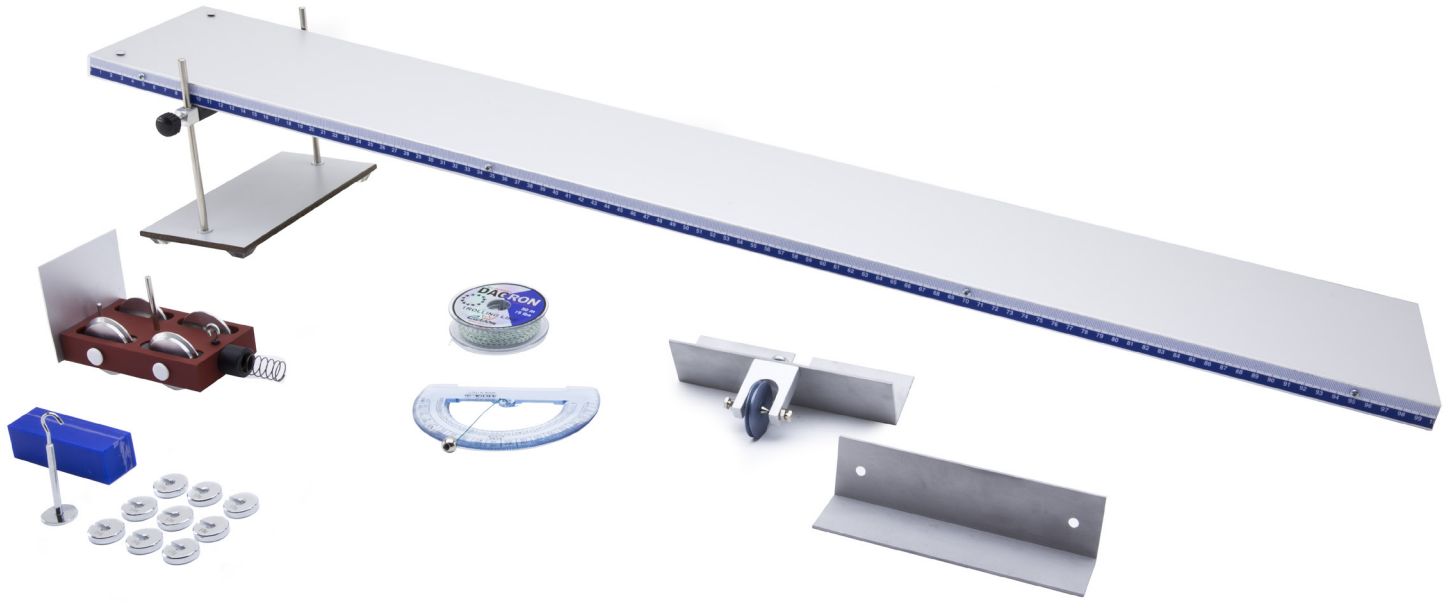
The movement plane, made up of the overlapping of a layer of plastic and one of aluminum, allows for an in-depth study of the basic motions of the dynamics: uniform rectilinear motion and uniformly accelerated rectilinear motion. The uniform motions can be achieved using the plane with the metal surface facing upwards, thanks to the phenomenon of electromagnetic induction generated by the movement of the magnetic carriage on the aluminium. Conversely, by placing the trolley on the plastic surface, it is possible to obtain the accelerated motions. Thanks to the special support, the plane of movement is transformed into an inclined plane which also makes possible considerations on friction and conservation of mechanical energy. For the execution of quantitative experiments it is necessary to have a distance sensor, such as the cod. 9041.

Covered Topics

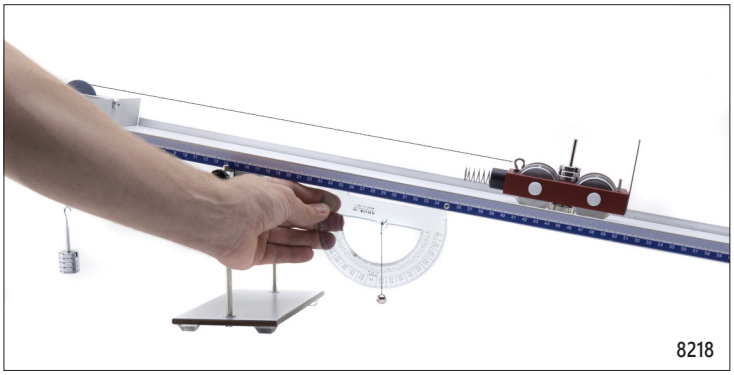
- Motion of a carriage on an inclined plane
- Law of the inclined plane
- Magnetic carriage (electromagnetic induction)

Material Provided

- 1 Double layer aluminum / faesite plane 100 cm long
- 1 Trolley with dimmer and magnet
- 1 Plane tilting device
- 1 Attachable rigid barrier
- 1 Hookable pulley
- 1 Semigoniometer with plummet
- 1 Set of 9 10g masses + 10g sinker
- 1 Wire

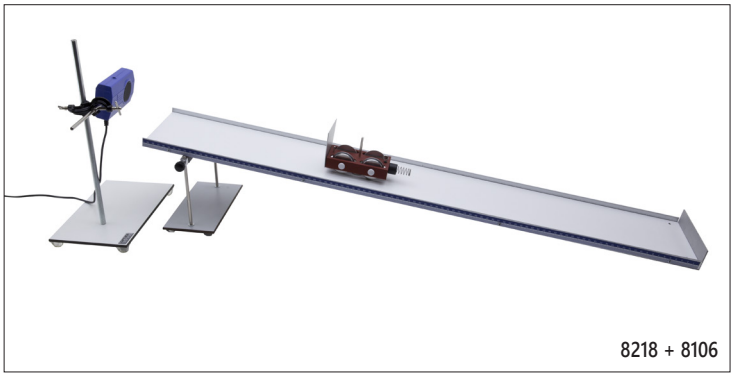


Examples of experiences with an inclined plane



8218

Verification of the law of the inclined plane: the force on the trolley depends on its weight and on the angle of the plane.



8218 + 8106

The accelerated motion is obtained by removing the magnet from the trolley and making it move on the plastic surface while the uniform motion is obtained by applying the magnet to the trolley and making it move on the aluminum plane

8218

The motion plan experience can be expanded with the following add-ons:

Sensor kit (accessory for 8218) 8106

This additional kit to the movement plan allows you to obtain position / time graphs via a simple bluetooth connection, so as to collect the data of the experiences carried out and understand them more deeply.

Topics

- The distance sensor
- Uniform rectilinear motion
- Uniformly accelerated straight-line motion
- Elastic impact

Material Provided

- 1 Base
- 1 Double clamp
- 1 Modular metal rod
- 1 USB distance sensor (Korea Digital)

8106

Friction kit (accessory for 8218) 8102

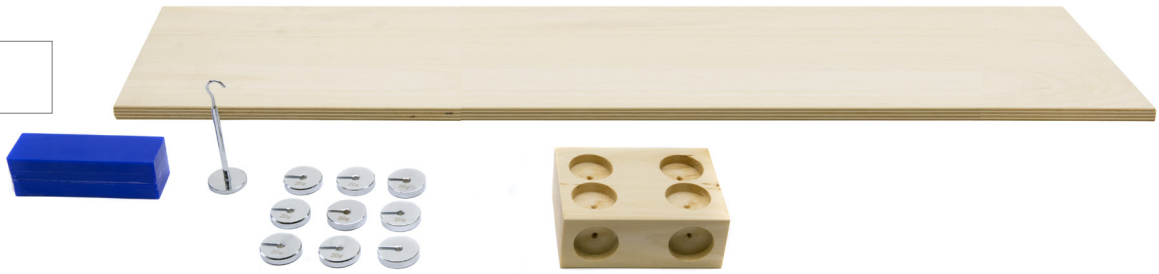
This motion plane add-on kit allows you to measure the coefficient of friction between different materials and understand their mechanisms.

Topics

- Measurement of the static sliding friction coefficient
- Measurement of the dynamic sliding friction coefficient

Material Provided

- 1 wooden block with spaces for weights
- 1 wooden top
- 1 Series of 9 masses of 20g + 20g plate



8102

Rolling kit (accessory for 8218) 8105.1

Thanks to this additional movement plane kit, it will be possible to carry out experiments regarding the dynamics of rolling and how this is linked to the moments of inertia of rolling bodies, leading to unexpected phenomena.

Topics

- The dynamics of rolling
- Rolling of a cylinder on an inclined plane
- Speed race between two different cylinders
- Speed race between cylinders with different mass distribution
- Rolling of a sphere on an inclined plane
- Speed race between two different spheres
- Speed race between a sphere and a cylinder
- Rolling of a sphere on a track
- Speed race between a sphere on an inclined plane and a sphere on a track
- Speed race between different spheres on the same track

Material Provided

- 1 U-shaped aluminum profile 800x30x30 mm
- 1 aluminum cylinder diam. 55mm
- 1 PVC cylinder diam. 55mm
- 1 aluminum cylinder diam. 39mm
- 1 marble diam. 57mm
- 2 marbles diam. 51mm
- 1 External brass cylinder – internal PVC
- 1 PVC external cylinder – brass internal

8105.1

Einstein's lift 1428

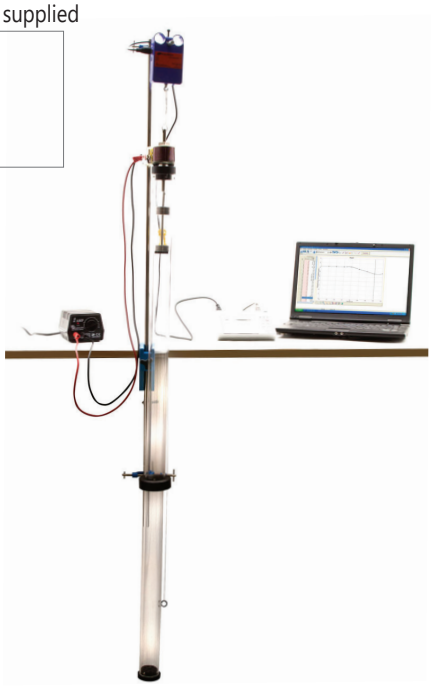
This lift is composed of a pair of aluminum disks fixed to a common pivot, free to slide inside a plexiglass tube. The elevator may be initially anchored to the upper end of the tube by means of an electromagnet. Releasing the electromagnet, the elevator falls in free fall along the tube down to the lower end. A wire is then distributed to the repechage of the elevator. A system of holes, drilled on the caps, prevents the indoor air compression from slowing down in the elevator during the falling.

Equipment supplied

1 110 cm long plexiglas cylinder, equipped with PVC caps
1 Electromagnet
1 Clamp
1 Electromagnet power supply with cables
1 Force sensor support
1 Box
1 Elevator consisting of two aluminium discs fastened to the same pin
1 12 mm diam. rod, L 120 cm
1 PVC ring with rod
1 String
2 Bosshead

Equipment for online use - not supplied

1 Interface code 9001
1 Force sensor code 9032
or
1 USB force sensor code 9068
or
1 Bluetooth force sensor code 12943-00



Suitable to be used with sensors

1428

Kit for measuring short time intervals 1417

With this kit it is possible to measure time interval between two occurences when time is too brief to be measured with a time marker. For example, oscillation time, or the time takes a body, to cover a specific distance, etc.

Equipment supplied

1 Timer and photocells (2pcs)
1 Metal rod 70 cm
1 Base
2 Bosshead
1 Linear ruler
1 Rod with hook
1 Spring
9 masses 10 g
2 Spheres for pendulum
1 String
1 Box

1417

Online low friction track 8119

Anodized aluminium track, length: 120cm, on which two friction trolleys, fitted with two wheels mounted on low-friction bearing, can scroll.

Topics

- How to mount the rail
- Gliders
- The distance sensor
- Uniform motion
- Uniformly accelerated motion
- Newton's second law
- Conservation of energy
- The impulse-momentum theorem
- Elastic collisions
- Inelastic collisions
- Oscillations of a spring-mass system

Equipment supplied

1 Track
1 Stand with one support
1 Stand with double support
1 End run shore
1 End run with pulley
2 Photocell supports
2 Stands with bar
2 Bossheads
1 Mass 500 g
9 slotted masses 10 g with holder
2 Pivots for springs
1 Linear ruler
2 Coil springs
1 Central pivot
2 Side pivots
1 Spring
1 Support for inclined plane
1 Friction-trolley with bumper
1 Friction-trolley without bumper
2 Reflectors
4 Magnets
1 Allen key
1 USB-cable
1 Box

Equipment for online use - not supplied

2 Distance sensor code 9041
1 Force sensor code 9032
1 Interface code 9001
or
2 USB distance sensor code 9066
1 USB force sensor code 9068
1 Interface code 9001

Suitable to be used with sensors

8119

Low friction track 1442

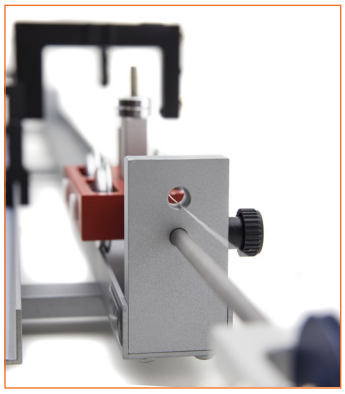
Motion is subject to friction forces which can be reduced but not cancelled.
Thanks to the low friction track you can carry out experiments on kinetics and translational motion.e.
15 feasible experiments

Topics

- Motion
- Motion is relative
- Reference systems
- Physical quantities defining motion
- Trajectory
- Displacement
- The instruments for the experimental study of motion
- Average speed
- Instantaneous speed
- Average acceleration
- Instantaneous acceleration
- Different types of motion
- Uniform rectilinear motion
- Uniformly accelerated rectilinear motion
- The principle of inertia
- The fundamental law of dynamics
- Friction force

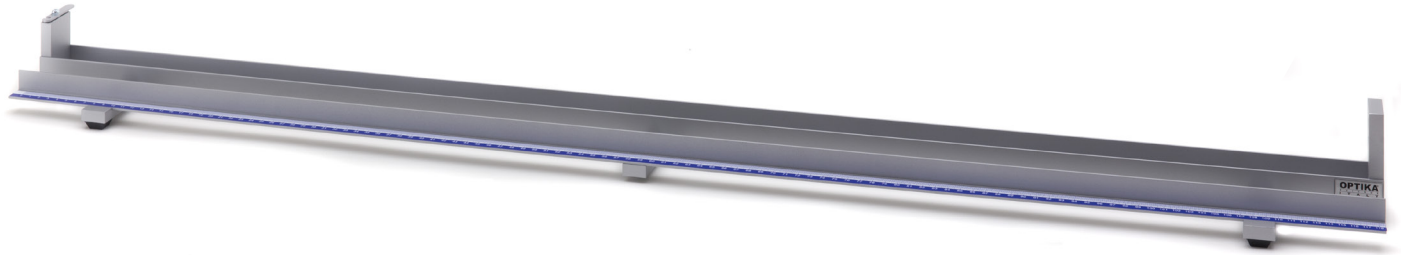
Equipment supplied

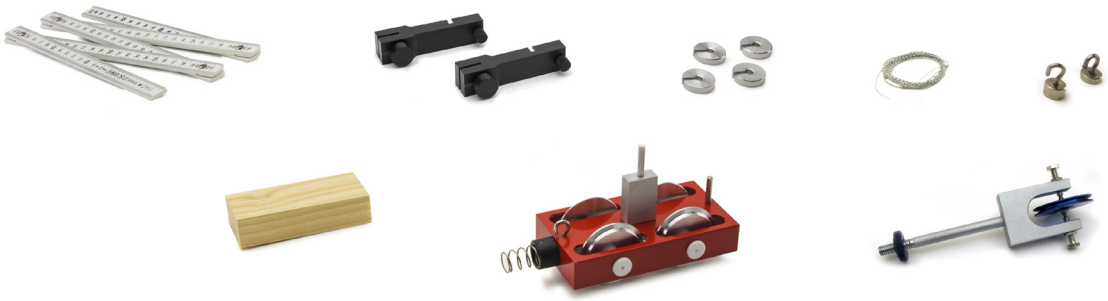
1 String
1 Folding ruler
4 Slotted masses 10 g with masses holder
1 Track
1 Glider
1 Mass with hook 5 g
1 Mass with hook 8 g
1 Wooden block
1 Pulley with rod
2 Photocell holders
1 Box



Equipment required - not supplied

1 Timer e photocells code 9081





Timer system 9081

Recommended for low friction track code 1442.
Description:
2 Photocells.
1 Timer.

Timer description:
- Readability: 0.001s
- 9V battery included
- 2 modes:
To measure darkening time
To measure elapsed time between the darkening of the first photocell and the second one.

9081

1442

150 cm - Air Track	**5588**
190 cm - Air Track	**5589**
200 cm - Air Track	**5590**

Optika Air Tracks are made from the extrusion of a square aluminum tube.
Each Air Track is provided with a side T-shaped aluminum profile on which photocell holders can slide.
On this profile a graduated scale is mounted for a clear reading of the photocell positions.

It is an essential instrument thanks to which students are able to practice with Newton's second law, uniform motion, uniformly accelerated motion, conservation law and collisions.

Topics

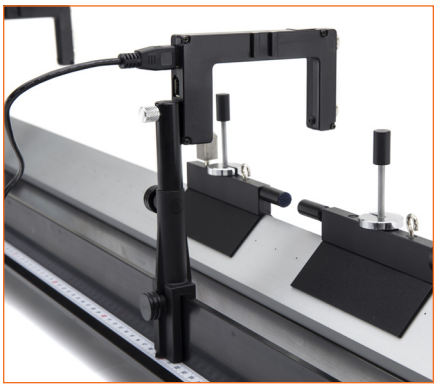
- How to set up the system
- Uniform rectilinear motion
- Uniformly accelerated rectilinear motion
- The fundamental law of dynamics
- I sistemi isolati
- Momentum conservation
- The principle of energy conservation
- Elastic collisions
- Elastic collisions between two gliders
- Elastic oscillations
- Free falling bodies (optional kit using product code 5455)

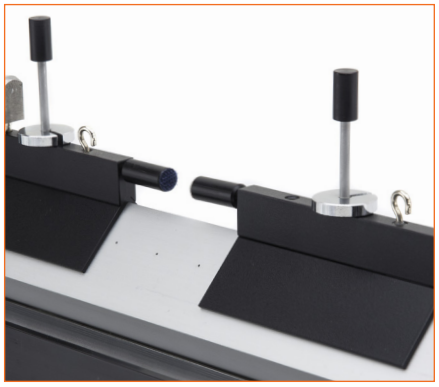
Equipment supplied

1 Track
2 Gliders
4 Cylindrical flags
1 Couple of velcro bumpers
1 Elastic bumper
2 Spring bumpers
4 Hookes for springs
1 Set of slotted masses
2 Photocells holer
1 String
4 slotting masses 20 g
2 Springs
1 Level

Equipment required - not supplied

Photocells	cod. 5453 (2pcs required)
Timer	cod. 5452
Air blower	cod. 5450
Electromagnet	cod. 5454





Air blower 5450

Dimension: Ø 20 cm x h 30 cm.
Electrical socket on top with fuse.
Tube length: 2 m.
Engine power: 300 W.

5450

Photocell 5453

This photogate works as a switch.
The infrared transmitter and receiver are mounted and aligned on a plastic fork.
Lead time: ~ 0.004 ms.
Includes connection cable for timer 5452 and 13 cm metal support rod.

5453

Electromagnet 5454

Release system usable with timer code 5452.
Connection cable for timer code 5452 included.

5454

RTL track kit 5456

Thanks to this kit, students are allowed to study dynamics using a Real Time Laboratory method. This kit is suggested for 150 cm Air Track only (code 5588) and air blower (code 5450).

Equipment supplied

1 Clamp	2 Reflectors for distance sensor
1 Base	1 Square pivot
2 Bosshead	2 Massholder
3 Metallic rod 350x10	1 String

Equipment for online use - not supplied

2 Distance sensors	cod. 9041	1 Interface	cod. 9001
1 Force sensor	cod. 9032	1 Balance	

Suitable to be used with sensors

5456

Timer 5452

Multifunctional control unit for:

- **5588 (5589-5590)**
- **5455**

For these instruments are guaranteed experiments on the following topics:

- Uniform rectilinear motion
- Uniformly accelerated motion
- The fundamental law of dynamics
- The principle of conservation of energy
- Elastic shocks
- Elastic oscillations
- Free fall of a grave

For correct functioning, a maximum of two photocells code 5453 and one solenoid code 5454 are required. Power supply unit included.
Power supply included.

5452

Free falling bodies kit 5455

The free falling apparatus allows student to study the free fall of a body getting accurate and reliable measurements.

Equipment supplied

3 Bosshead
1 Clamp
1 Metallic rod 12 x 1200 mm
1 Saucer
1 Plumb-line
1 Sphere diam. 12 mm
1 Sphere diam. 16 mm
1 Folding ruler
1 Electromagnet support

Equipment required - not supplied

1 Electromagnet	cod. 5454
1 Timer	cod. 5452
(2pcs code 5453 are required)	

5455

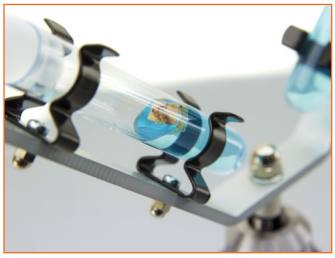
Electrical rotating platform 1443

Optika rotating platform allows students not only to verify the relations between the fundamental quantities which characterize rotational motion, but also to perform experiments on an important topic: inertial and non-inertial systems. What is seen by an observer on an inertial system is different from what is seen by an observer on a non-inertial system. In this way students are allowed to understand which is the origin and which are the results of fictitious forces as the centrifugal force and Coriolis force.

Thanks to this platform, you are able to study a lot of fundamental topics as the effects of Coriolis force on solids and liquids and understand why a mathematical instrument as the cross product was so important. By which magnitudes the centrifugal force depends on? Let's perform some experiences with OPTIKA rotating platform.

Topics

- The relativity of motion
- Galileo equations
- Invariant and non-invariant quantities
- The principle of relativity
- Non-inertial references
- Systems with tangential acceleration only
- Motion in two dimensions
- Uniform circular motion
- Centripetal force
- Systems with only radial acceleration
- Rotating platform
- Centrifugal force
- Effects of centrifugal force
- Conical pendulum
- Coriolis force
- Examples of Coriolis forces
- Properties of Coriolis force
- The Earth: a rotating reference system
- The centrifugal force on the Earth's surface
- Coriolis force on the Earth's surface
- A proof of the Earth's rotation: Foucault pendulum



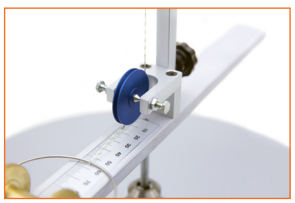
Feasible experiments

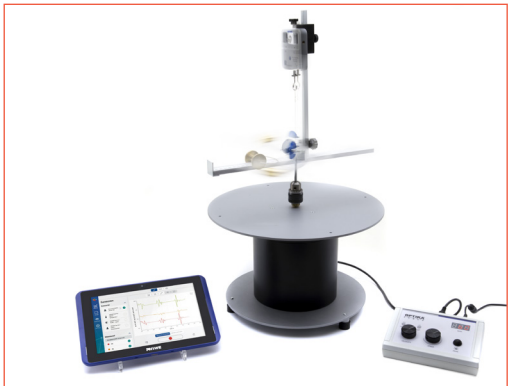
1° Centripetal force
2° A fictitious force: the centrifugal force
3° Lack of centripetal force: what happens?
4° Centrifugal forces in equilibrium
5° How to use centrifugal force to separate a mixture
6° Centrifugal force and Earth shape
7° Watt's regulator
8° White light: Newton's Disk
9° Conical pendulum
10° Properties of conical pendulum
11° How to verify centripetal and centrifugal forces formula
12° Another fictitious force: Coriolis force
13° Coriolis force acting on a water jet
14° Coriolis force acting on a pendulum
15° Observer in a non-inertial system
16° How to verify Coriolis law with an experiment
17° When Coriolis force is zero
18° Foucault's pendulum

1443

Apparatus for measuring centrifugal force for force sensor 1135-SENS

The instrument consists of a rail on which a cylinder can slide.
By putting the # 1443 rotation machine into operation, the device will be able to record the centrifugal force values thanks to the Bluetooth force sensor. For use with sensor # 12943-00.
For data acquisition, the use of the Cobra SMARTlink # 12999-99 data logger is recommended.
By processing the data with the free measureAPP application, you will be able to appreciate the dependence of the centrifugal force on angular speed and arm.





12999-99 + 1443 + 1135-SENS + 12943-00

1135-SENS

Accessories (not included) for Electrical rotating platform

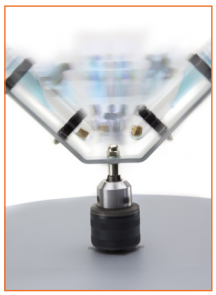
Apparatus for centrifugal force 1445
To performe experiment n° 2


1445

Coaxial cylinders 1447
To performe experiment n° 4


1447

Apparatus with inclined test tubes 1082
To performe experiment n° 5

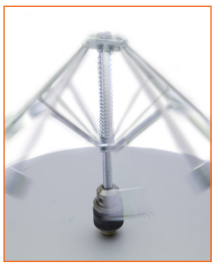



1082

Apparatus with elastic rings 1094
To performe experiment n° 6


1094

Watt's regulator 1093
To performe experiment n° 7




1093

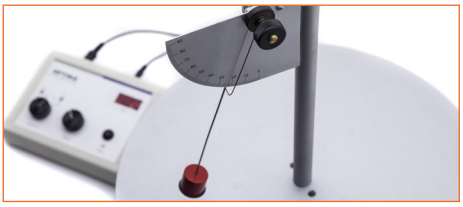
Newton's Disk 1097
To performe experiment n° 8

1097

Bowl with dye 1459
To be used with code 1452 and code 1458.

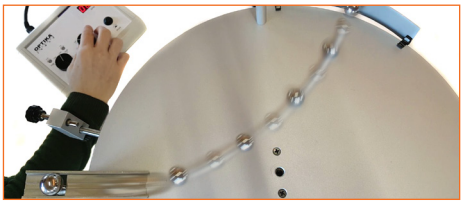
1459

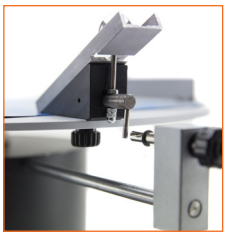
Conical pendulum 1450
To performe experiments n° 9-10-11.



1450

Apparatus for Coriolis force 1451
To performe experiments n° 12-16.

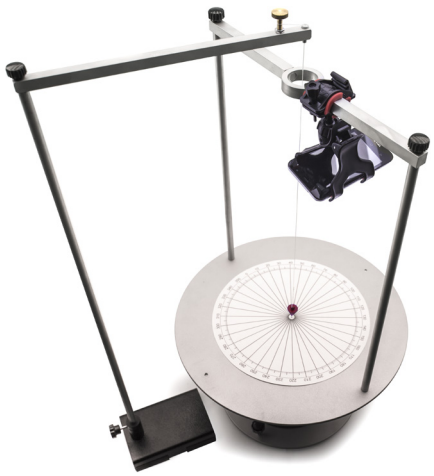




1451

Simple pendulum 1453
To performe experiments n°14-15-18.

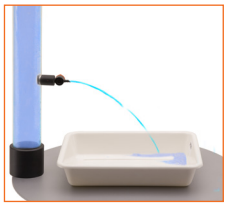
Camera kit 1455



The clamp shown in the photo is a smartphone support.

1453 - 1455

Apparatus for water jet 1452
To performe experiment n° 13.


Bowl not included

1452

Apparatus for falling water 1458
To performe experiment n° 17.



Bowl not included

1458

Small manual rotating machine 1109

Laminated wood top, 180 x 340 mm. The rotating machine is equipped with a metallic spindle for shafts with 6 mm diameter.

1109

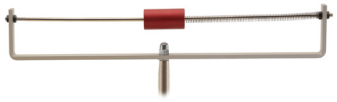
Watt's regulator 1093

It represents a model of centrifugal regulator.
During rotation the two masses move away, compressing the spring.
To be used with a rotating machine.

1093

Centrifugal force device 1081

By mounting the device on a rotating machine, the more the angular velocity increases, the more the cylinder compresses the spring.
To be used with any rotating machine.



1081

Device to measure centrifugal force 1135

It consists of a rail on which a low-friction cylinder can slide. By rotating the device, it is possible to read on the spring scale, the value of the centrifugal force, and it is possible to check the centrifugal force formula.

1135

Elastic rings 1094

They allow to highlight that the centrifugal force grows with the distance from the axis of rotation. During operation they assume an elliptical shape.

1094

Coaxial cylinders 1092

Since one has twice the mass of the other, during rotation there is equilibrium if the distance of the center of gravity of the greater mass from the center of rotation is half the distance of the smaller mass.

1092

Newton's disk 1097

Divided into colored sectors, while rotating, it allows to verify the additive synthesis of spectral colors.

1097

Device to study rotational motion 8109

With this device it is possible to perform experiments on the dynamics of rotational motion and on the moment of inertia of rotating bodies, by using astopwatch (not included).

10 feasible experiments

Topics

- Uniform circular motion and harmonic motion
- Kinematics of rotational motion
- Similarities between translatory and rotational motion
- The dynamics of rotational motion
- The fundamental law of rotational motion
- Inerzia momentum
- The kinetic energy of rotational motion
- Conservation of mechanical energy
- How to use the distance sensor

Equipment supplied

1 Base
1 Rod with chuck
1 Clamping device
1 Rod with sphere
1 Rod for balancer
1 Red mass
1 Green mass
1 Aluminum disk diam. 320mm
1 Mass holder
5 Slotted masses 10 g
5 Slotted masses 20 g
1 Clamp
1 Bosshead
1 Rod with pulley
1 Metallic rod 10x470 mm
2 String
2 Pins
1 Folding ruler
1 Box

Equipment for online use - not supplied

1 Interface	cod. 9001
1 Distance sensor	cod. 9041
or	
1 USB	cod. 9066

Suitable to be used with sensors

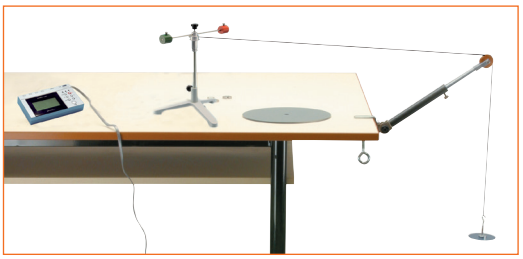
8109

Kit to study translational, rotational and oscillatory motion 8120

This kit has been designed to allow students to perform experiments on translational, rotary and oscillatory motion in real time, using a distance sensor.

Topics

- Rotational motion
- Uniform rectilinear motion
- Uniformly accelerated rectilinear motion
- Measurement of the acceleration due to gravity
- Simple pendulum
- Compound pendulum



Equipment supplied

1 String
1 Base
1 Bosshead
1 Folding ruler
1 Metallic rod 10 x 750 mm
1 Mass-holder 20 g
1 Clamp with telescopic arm
2 Masses 10 g
20 Plumb spheres 0.3 g
1 Aluminum disk
1 Spindle
1 Rod
2 Masses
1 Compound pendulum
1 Simple pendulum
1 Spindle support
1 Atwood machine support
1 Mass-holder
1 Pulley for Atwood machine
1 Box

Equipment for online use - not supplied

1 Distance sensor code 9041 + interface code 9001
or
1 USB distance sensor code 9066

Suitable to be used with sensors

8120

Rotating platform 1177

The rotating platform is characterised by a sturdy metal structure and a couple of conical bearings which allow it to rotate ensuring great resistance to stresses and low friction. Thanks to the didactic guide and the several accessories supplied with this collection, students will be able to carry out experiments on non inertial reference frames which otherwise would be impossible to perform. Our rotating platform is a particular and interactive instrument particularly suited to study angular momentum, moment of inertia and centrifugal force.
Platform diameter: 50 cm

Topics

- Action and reaction principle
- Preservation of the angular momentum
- Non-inertial systems: uniform rotatory motion
- Non-inertial systems: free falling
- Centrifugal force and its effects
- Measurement of centrifugal force
- Centrifugal force depending on the rotation radius
- Centrifugal force depending on the angular velocity
- Coriolis force
- Inertia moment

Equipment supplied

1 String
2 Spring tweezers
1 Rotating platform
1 Aluminum tube 800x35 mm
1 Ring stand for vertical tube
1 Ring stand for falling plane
1 Complete bicycle wheel
1 Plane with cannon
1 Falling plane
1 Device for measuring the centrifugal force
2 Dumbbells 4 Kg
1 Inclination protractor
1 Metal rod 1200 x 18 mm
3 Steel spheres
1 Support for launch system
2 Clamp for round flasks with bosshead

Equipment not supplied (not necessary)

1 Tripod base

1177

Simple pendulum 1272

This Simple Pendulum device can be used to verify the laws of simple oscillations.
More specifically, it can be used to verify that initial potential energy is preserved regardeless of the trajectory (Galileo's pendulum).
The pendulum is supplied with 3 different spheres with strings.
Height: 70 cm.

Accurate measurements can be aken using a distance sensor (not supplied):

-Cod. 9066
or
-Cod. 9041 and -Cod. 9001

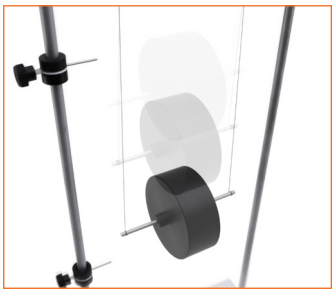
1272

Maxwell's pendulum 1375

Maxwell's pendulum is composed of a wheel suspended by two strings. These strings will be rolled up on an axis passing through the wheel's centre of mass. Releasing the wheel, the two strings are rolled up and down on the axis. If there was no friction, the wheel would reach the initial elevation. This up&down motion will be repeated many times. Its period depends on: the initial height h, from which the wheel was released, the gravity acceleration g and the ratio between the wheel radius and the pivot radius.
Using the distance sensor (not supplied) students are allowed to evaluate the wheel velocity and to make accurate calculations.

Equipment for online use - not supplied

1 Interface	code 9001
1 Distance sensor	code 9041
or	
1 USB distance sensor	code 9066

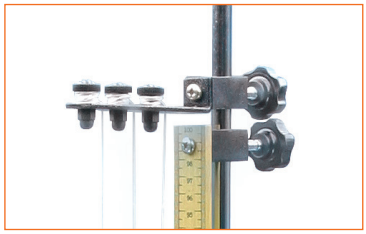


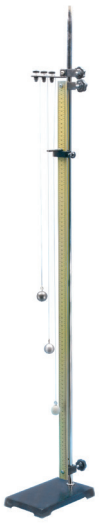
Suitable to be used with sensors

1375

Simple pendulums apparatus 1104

Composed of 3 simple pendulums whose length can be changed through specific handwheel and whose masses are different. Thus, you can demonstrate that the period of a simple pendulum depends on the length, but doesn't depend on the mass. A T-shaped rod able to move along a vertical stand, allow you to release all 3 pendulums at the same time.
Height: 100 cm.





1104

Set of 5 pendulum spheres 1306

Spheres with hook Ø 25 mm.
Material: aluminium, brass, iron, wood, copper.

1306

Forced oscillation apparatus 1302

This device allows the study of the phenomenon of a system's forced oscillations and lets you observe what happens under resonance conditions.

Equipment supplied

1 Base
1 Metallic rod
1 Pulleys system - low friction
5 Springs
1 Slotted masses 20g
1 Slotted masses 10g
1 Bosshead
1 Graduated cylinder
1 Vibrator
1 String
2 Connection cables

We suggest to use our functions generator code 5718, not supplied with this equipment. It has to be use with the vibrator supplied.

1302

Apparatus to study harmonic oscillations 8111

The study of the oscillatory motion of a mass hanging by a spring allows students to be introduced to the motion features of an harmonic oscillator and to get acquainted with one of the most powerful models for the physical interpretation of a wide range of phenomena.

Topics

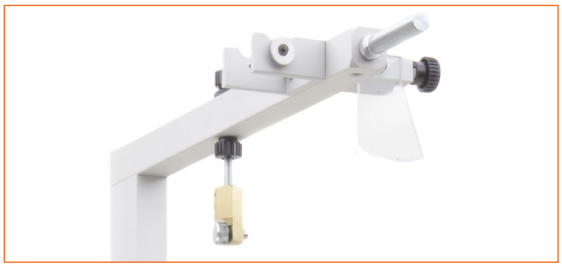
- Hooke law
- Armonic motion
- Mass-spring system
- Simple pendulum
- Physical pendulum
- Torsion pendulum

Equipment supplied

1 Metal support with rod and upper cross-bar for pendulums
1 Kit composed of 4 springs and 1 elastic
1 Wooden sphere for simple pendulum, diam. 50 mm
1 Polystyrene sphere, diam. 50 mm
1 Polystyrene sphere, diam. 160 mm
1 String
1 Compound pendulum
2 Metallic cylinder
1 Lower cross-bar with protractor for torsion pendulum
1 Brass rod 2 x 600 mm
1 Steel rod 2 x 600 mm
1 Steel rod 2 x 300 mm
1 Steel rod 2,5 x 600 mm
1 Torsion pendulum rod
1 Mass holder
1 Reflector disk
4 Masses 10 g
4 Masses 20 g
1 Bosshead
1 Base
1 Allen key

Equipment for online use - not supplied

1 Distance sensor code 9041+ interface code 9001
1 Force sensor code 9032
1 Sensors holders code 4014



Suitable to be used with sensors

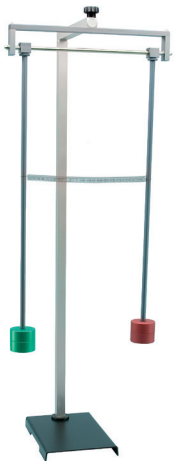
8111

Coupled pendulum 8113

The apparatus of coupled pendulums consists of two pendulums paired through a coil spring slightly stretched out. The spring allows the energy to be transfered between the two pendulums so it is possible to study the phenomena of resonance and beats.
The apparatus of coupled pendulum can be used as optional equipment of the apparatus for the study of harmonic oscillations (code 8111) or with the stand (code 0209), sold separately.

8113

Stand for coupled pendulum 0209



0209

Apparatus to study the moment of inertia 1438

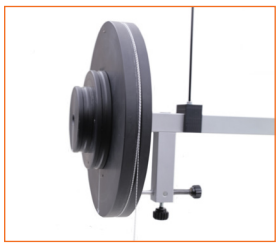
Thanks to this device, students can delve into complicated concepts such as angular velocity and moment of inertia, based on the fundamental law of rotary motion. The discussion also includes the energy balance of the system, including friction.

Topics

- Translational motion and rotational motion
- Analogies between translational and rotational motions
- Definition of rotational motion quantities
- How to calculate torque
- How to evaluate acceleration
- The fundamental law of rotational motion
- The moment of intertia
- Kinetic energy in rotational motion
- How to determine the friction force
- Energetical balance in the presence of friction
- The moment of inertia of composite systems
- The equilibrium of a rigid body

Equipment supplied

1 Base
1 Pillar 20x20 mm
1 Disk support
1 Disk 200 mm; peso 1,1 kg
1 Double disk diam 100 mm
1 Mass holder 2 g
3 String
1 Indice di riferimento
1 Allen key n. 6
1 Slotted mass 0,5 g
1 Slotted mass 1 g
2 Slotted masses 2 g
9 Slotted masses 10 g with holder
1 Measuring tape 2 m



1438

Atwood machine 1437

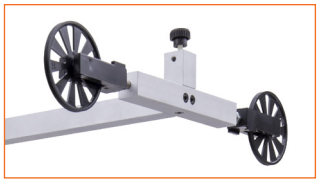
Atwood's machine was invented in 1784 by George Atwood as a laboratory experiment to verify the laws of motion uniformly accelerated. With this apparatus it is possible to conduct experiments on the Dynamics of moving bodies and perform accurate measurements. Using the appliance cod. 8107 it is possible to study even the uniform motion.

Topics

- Newton's second law
- Atwood machine - Theory
- Friction force
- Newton's second law in the presence of friction

Equipment for online use - not supplied

1 Interface code 9001
1 Distance sensor code 9041
or
1 USB distance sensor code 9066



Suitable to be used with sensors

1437

Uniform linear motion apparatus 8107

This item is composed of a couple of neodymium magnets which are dropped into an aluminium tube. During their fall, the tube is the centre of induced forces which, due to Lenz's Law, oppose the magnets motion. The kit of magnets is submitted to a force F = - k v, which is proportional and opposite to the speed. Therefore, after a brief transitional phase, the motion of the two magnets becomes uniform thanks to this force. Connecting trolleys or other objects to the magnets through a cord, it is possible to obtain the uniform motion of these objects. The proposed experiments can be performed using the force sensor (not supplied) Cod. 12943-00.

Topics

- Falling of a magnet in an aluminium tube;
- Verification of the action-reaction law;
- Uniform motion with Atwood machine (code 1437)

In order to realize the third experience of the uniform motion is necessary to have the product code 1437.

Equipment supplied

1 Base
2 Bosshead
3 Rods 350 x 10 mm
1 Spring scale 1000 g
1 Magnets kit
1 Perforated stopper
4 Masses 10 g diam. 4 mm
2 Clamps with bosshead
1 Aluminium tube with ring-shape support
1 Magnets container
1 PVC ring - guide for tube
1 Spring scale support
1 Rod with hook
1 pdf teaching guide

Equipment for online use - not supplied

1 Interface code 9001
1 Distance sensor code 9041
or
1 USB distance sensor code 9066

Suitable to be used with sensors

8107

Newton's cradle 1113

It is composed of five steel balls of equal mass, lined up and in contact with each other. Raising the first ball and then releasing it, its energy are trasmitted to the last ball. This phenomenona doesn't happen if you place a disk of deforming material between the balls.

1113

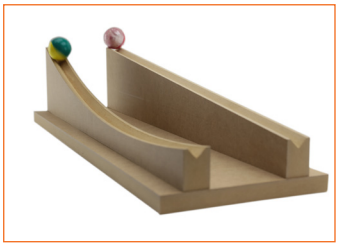
Gyroscope 1435

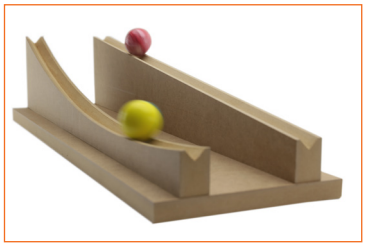
It has a metallic wheel. If you turn this wheel, using a string, you can study angular momentum conservation. Applying a perpendicular force to a rotation axe, you can observe precession motion, in other words the gyroscopic effect.

1435

Downward speed 1364

Two balls with the same diameter roll down at the same time, from the same height difference, but following different trajectories. Departing from the same height, which will be the fist ball to reach the finish point?
Base: 600x200 mm.
Length of tracks: 600 mm.
Starting altitude: 120 mm; Arrival fee: 45 mm.

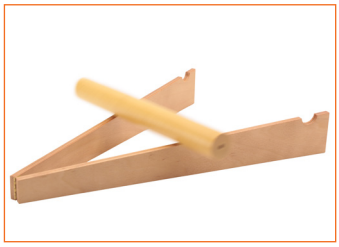




1364

Mechanical paradox 1079

As the cylinder goes down the inclined plane, the double cone goes up, apparently contravening the laws of mechanics. In reality the center of gravity of both moving bodies goes down. Made entirely of wood.
Length of the inclined plane: 50 cm.
Double cone dimensions: 35 cm.
Cylinder dimensions: 35 cm.



1079

Two-dimension collision apparatus 1325

A steel ball rolls down a track to finally fall freely, leaving a trace on the fall plane thanks to a carbon-paper sheet.
It is possible to do calculations on energy conservation and on motion composition by changing the free fall height and by measuring the range.
With two balls, it is also possible to verify the conservation of the motion quantity and of the kinetic energy. The item is supplied with 3 steel balls.
Dimensions: 400x100x20 mm.

1325

Apparatus for the verification of the principle of mechanical energy conservation 1439

All the natural phenomena taking place in an isolated system are governed by a property that, until today, has had no exceptions: there is a magnitude whose value remains the same throughout the course of a phenomenon; this magnitude is named as energy. Thanks to this kit, the student can study the concept of energy and go into the meaning of its conservation.
The experiments suggested can be carried out using measurement sensors:
-Cod. 9095 or -Cod. 12945-00

Topics

- Isolated systems
- What energy is?
- Principle of mechanical energy conservation
- Why mechanical energy is preserved?

1439

Parabolic motion apparatus 1431

This simple apparatus let the students study, in a quantitative way, the parabolic motion. This launching system has 5 launch positions, and the projectile is a plastic sphere. The regulation system allows you to vary inclination from 0° to 90°.

Apparatus to measure launch velocity 9095

Looking for the speed of the projectile, launched by the launching system code 1431, we recommend our product code 9095. It consists of a photocell connected to a timer able of evaluating to the millisecond the obscuration time Δt caused by the passage of the projectile.
If Δx is the diameter of the projectile, its initial velocity is:

$$v = \frac{\Delta x}{\Delta t}$$

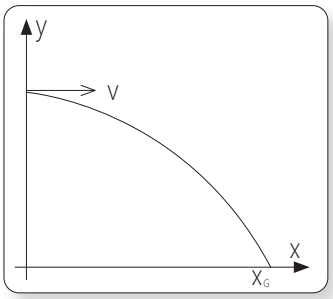
9095

Example

If cannon is h metres from ground, and it is horizontal, the rifle range depends on launch velocity:

$$X_G = V\sqrt{\frac{2h}{g}}$$

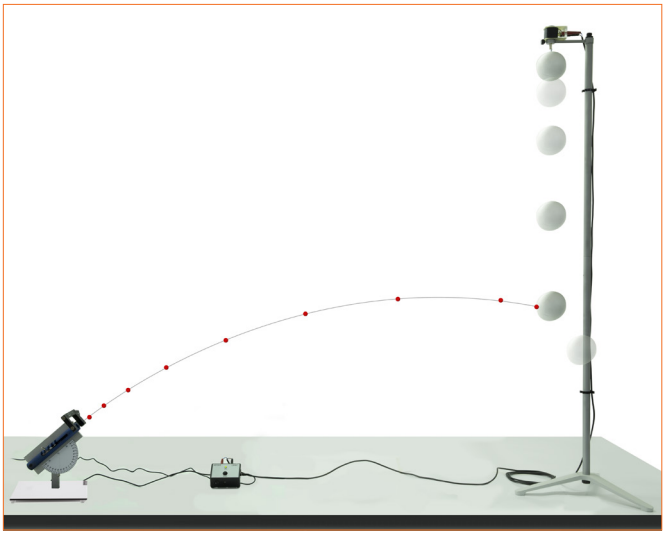
Knowing v, you can determine X_G and knowing X_G, you can appreciate V.



1431

An historical quest 1422

A hunter wants to shoot a monkey hanging from a tree branch, hence he aims his blowpipe at the animal. As soon as the monkey sees the arrow, it loosens the grip to avoid being shot. The hunter, as the monkey jumps, thinks he missed the target; shortly thereafter, however, he can see with great surprise the arrow hit the free falling animal.
It is possible to demonstrate that the monkey would be hit in all cases, whatever the velocity V_0 at which the arrow moves, provided that its value is such as to allow the arrow to hit the animal before it reaches the ground.
At the very instant in which the projectile exits the cannon, the photocell positioned on the muzzle sends a signal, deactivating the electromagnet which holds the polystyrene ball used to simulate the monkey. If the condition mentioned above is satisfied, while falling, the polystyrene ball will be hit by the projectile in any case. The apparatus we offer you is particularly sturdy. Moreover, the anodised aluminum cannon can be rotated and is characterised by a thick high pressure bilaminates base. This apparatus was entirely realised in our factory, from the production of its components to mounting.

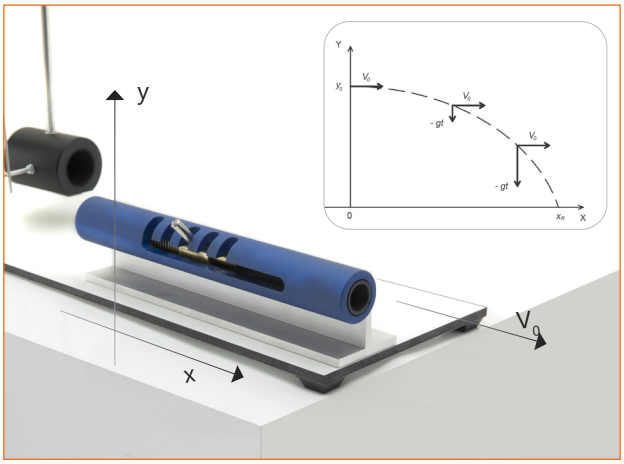


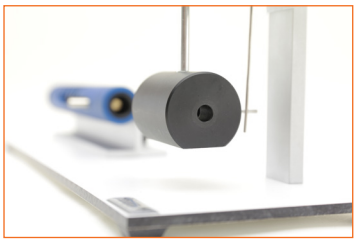
1422

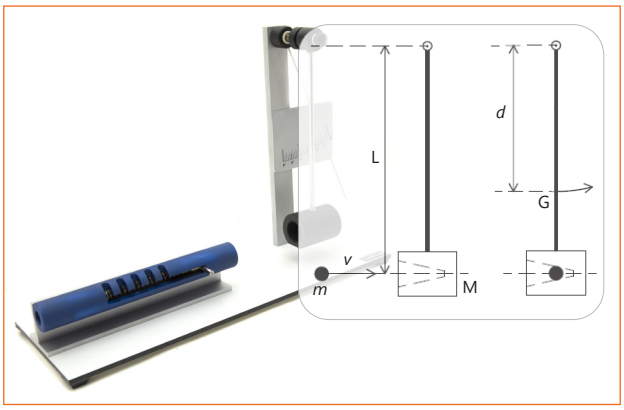
Ballistic pendulum 1436

The ballistic pendulum allows to study the laws of conservation of energy and the conservation of momentum in a perfectly inelastic collision.
The launching system is removable and suitable to verify the initial speed of a projectile according to the laws of parabolic motion.

The cannon is made of anodized aluminum.
It is equipped with 5 launching positions
and can be dismantled, this also allows
an in-depth study of the parabolic motion.







1436

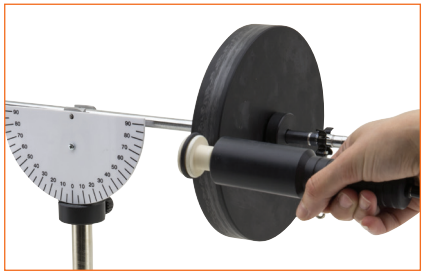
Precession motion 1432

This equipment allows students to study the precession motion thanks to the laws of classical mechanics applied to rigid bodies using simple devices as the spinning top and the gyroscope.

Equipment supplied

1 Gyroscope	1 Folding ruler
1 Giant Gyroscope	1 Launching motor
1 Spinning top	

By the giant gyroscope, you can also perform a quantitative test of the report that provides the value of the angular momentum precession as a function of mechanical momentum and angular momentum of rotation.
The teaching guide as well as a theoretical explanation of the phenomenon, provides instructions for a correct execution of the experiences.



1432

Communicating vessels 1105

For homogeneus liquids.
It is composed of 4 vessels.
Height of water columns 11 cm.

1105

Communicating vessels with capillaries 1062

It is composed of 5 vessels; the last two vessels are capillaries. Height of water columns 11 cm.

1062

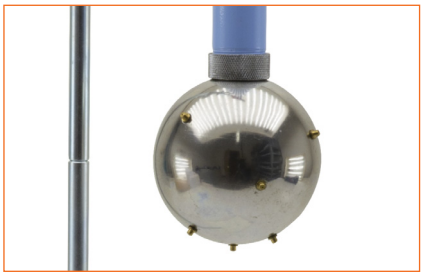
Capillary vessels 1106

It is composed of 4 vessels.
Height of water columns 11 cm.

1106

Pascal's principle apparatus with stand 1185

Pushing the piston, the water creates concentric circles on the basement plane.
Thi products is made of metal and it is supplied with base and stands.
Support height: 35 cm.



1185

Pascal's principle apparatus without stand 1248

The previous item cod. 1185, but without stand.

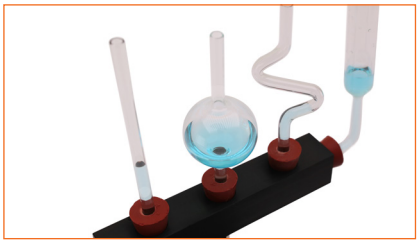
1248

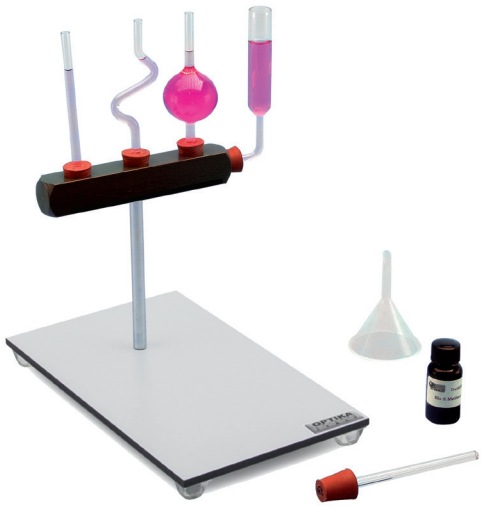
Pascal's apparatus with communicating vessels, modular model 1182

Thanks to this apparatus you will be able to perform experiments on communicating vessels, on capillary vessels, on Stevin's principle and on Pascal's principle.

Equipment supplied

1 Bosshead
1 Base
1 Dropper
1 Methylene blue bottle
1 Metal rod 10x250 cm
1 Funnel
1 PVC support
1 Rubber suction bulb
5 Glass tubes with different shape and rubber plug
3 L-shaped glass tubes
1 Box





1182

Cartesian devil 1125

This small glass object is hollow and has a small hole in its inferior part. If it is immersed in water, it floats. If you press the elestic membrane on the top, the devil fills itself up with water and finally it sinks. It starts floating again the moment the pressure on the membrane ends.
It is supplied with glass jar and rubber membrane.

1125

Archimede's double cylinder 1020

Made of plastic material and brass, it is endowed with hooks.
Dimensions: 53x55 mm.

1020

Apparatus for the study of viscosity 1001

It allows to experiment on the falling motion of a sphere in a liquid to determine the viscosity coefficient.

1001

Archimedes' principle apparatus 1170

Composed of : stand, spring scale, double cylinder, displacement vessel, beaker, graduated cylinder, case.

1170

Stevin's principle apparatus 1042

This apparatus is used to check Stevin's principle. It is supplied with base, manometer, tube, manometric sensor and jar.
Jar height :38 cm.

1042

Submarine simulator 1407

Thanks this instrument it's possible to observe how a submarine can vary immersion depth.

1407

Hare's apparatus 1219

Thanks to this apparatus, it is possible to determine the specific density of a liquid. A small depression done with a syringe, let the two liquids reach different levels, if they have different density. If the first liquid is water, it is possible to find the other liquid's density in relationship to the water's one. The item is supplied with stand, pincers, syringe and glasses. Glass part height 35 cm.

1219

Specific weight kit 1132

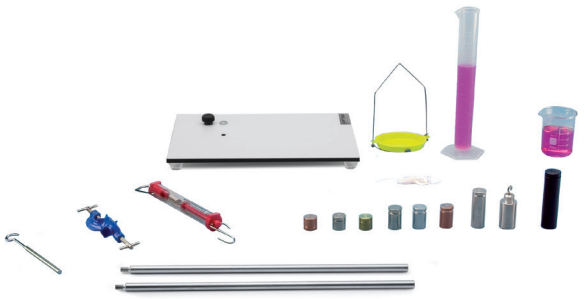
To measure the specific weight of solids and liquids.
The proposed experiments can be performed using the force sensor (not supplied) Cod. 12943-00

Topics

- Determination of the specific weight of a solid
- Bodies with the same weight but different volume
- Bodies with the same volume but different weight
- Determination of a specific weight of a liquid

Equipment supplied

1 Rod with hook
1 String
1 Folding metallic rod 70 cm
1 Bosshead
1 Pan for balance
1 Set of 5 samples with different volume and same weight
1 Set of 3 samples with same volume and different weight
1 Spring scale 2,5N
1 Base for rod
1 Aluminium object with hook
1 Graduated cylinder 100 ml
1 Beaker 100 ml
1 Box



1132

Cylinders with same mass 1368

Suitable for experiments on density-volume relationship. Diameter 15 mm; mass 50 g. Materials: aluminium, copper, brass, zinc, iron and lead.
6 pcs.

1368

Cylinder with same volume 1369

In order to do experiments on the density-volume relationship. Diameter 10 mm, height 40 mm. Materials: aluminium, copper, brass, zinc, iron and lead.
6 pcs.

1369

Series of cylinders 1124

Three cylinders have the same volume and different density; three cylinders have the same density but different volume. To demonstrate that Archimedes' thrust depends only on the volume of the immersed body.
5 pcs.

1124

Cubes with the same volume 1370

They are supplied with hook in order to measure the density of solid bodies. Length of the sides: 32 mm. Materials: aluminium, copper, brass, zinc, iron and lead.
6 pcs.

1370

Displacement vessel 1367

In order to measure the volume of solid bodies. Capacity: 600 ml.

1367

Pycnometer 1371

In order to measure the density of liquid bodies. Capacity: 100 ml.

1371

Density sphere 1372

Its weight allows the sphere to float if immersed in room-temperature water (<20°C) and to sink if immersed in hot water.
Sphere's diameter: 75mm.

1372

Capillarity tray 1366

Plexiglass triangular-shaped tray with 5° opening, suitable to prove the effect of capillarity. It shows the shape of the meniscus of wetting and not wetting liquids.

1366

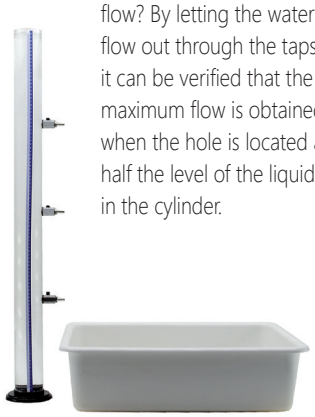
Pellat's apparatus 1381

With this item you can prove that the pressure of a liquid on the bottom of a container doesn't depend on the shape of the container, but it depends on the density and the depth of the liquid.

1381

Torricelli's apparatus 1426

After filling the cylinder with water up to a certain level, at which height should a hole be made to obtain the maximum flow? By letting the water flow out through the taps, it can be verified that the maximum flow is obtained when the hole is located at half the level of the liquid in the cylinder.



1426

Instrument to study superficial tension 1200

It allows you to calculate superficial tension of a liquid using Lecomte du Nouy'ring. The surface tension value is obtained from the difference between the ring weight and the maximum tension read on the spring scale one second before the ring leaves the water surface. Height: 75 cm.

Topics

1 Elevator table
1 Rod with base
1 Beaker 600 ml
1 Boss head with hook
1 Spring scale 1N
1 Aluminium ring

Equipment for online use - not supplied

1 Interface code 9001
1 Force sensor code 9032
or
1 USB force sensor code 9068
or
1 Bluetooth force sensor code 12943-00

Suitable to be used with sensors

1200

Vessel for hydrostatic and hydrodynamics experiments 8121
Spare part - glass - for code 8121 8121.1

Thanks to this item and to a pressure sensor it is possible to check that the pressure on each surface element immersed in a liquid is independent from the surface's orientation and its value is equal to the weight of a liquid's column having the considered surface element as a base and as the height the height difference between the center of this surface and the free surface of the liquid. It is also possible to experiment with the outflow's speed of a liquid under the gravity's effect and with the thrust that a solid body receives when it is immersed in a liquid (Archimede' principle).

Topics

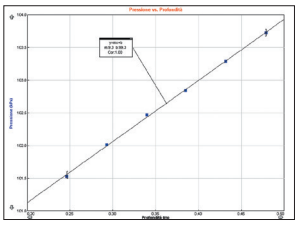
- Experimental verification of Stevino's Law;
- Experimental verification of Toricelli's Law;
- Experimental verification of Archimede's principle.

Equipment supplied

1 Glass cylinder with base and tap
1 Sensor holder and probe holder cap
1 PVC tube with drainage
1 Beaker 1 dm3
1 PVC cylinder
1 Aluminum cylinder
1 Base

Equipment for online use - not supplied

1 Interface code 9001
1 Pressure sensor code 9034
1 Force sensor code 9032
2 Metal modular rods
1 Bosshead code 0159
1 Metal rod 25 cm code 7108
1 Base code 1462



Suitable to be used with sensors

8121 - 8121.1

Vessel for experiments on hydrostatic-equilibrium 8122
Spare part - glass - for code 8122 8122.1

This vessel is an accessory of the cod. 8121 for the study of hydrostaticequilibrium. With the vessel code 8121 and the accessory code 8122 you can perform two additional experiments about communicating vessels:

- Water balance with two vases having the same capacity;
- Water balance with two vases having different capacity.

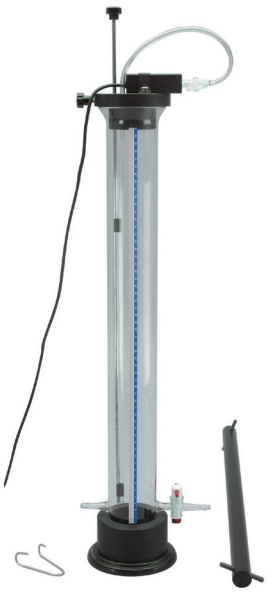
In particular, when two vases containing the same liquid at different levels are connected, a flow of liquid occurs from the vase in which the level is higher to the vase in which the level is lower. The flow goes on until the height difference is cancelled. During the transitory phase the higher level decreases over the time following an exponentially decreasing law.

Equipment supplied

1 Glass cylinder with base, tap and rubber holder
1 Sensor holder and probe holder cap
1 Transparent PVC tube
1 Base
1 PVC rod
1 PVC rod support

Equipment for online use - not supplied

1 Pressure sensor type B code 9034



Suitable to be used with sensors

8122 - 8122.1

Single stage rotary pump 1415

The rotary vane vacuum pump is designed to create vacuum in a sealed container.
Single-stage; recycled lubrication, tank, fan, silencer.
Voltage: 220V 50Hz
Flow rate: 2.55 m^3/h
Ultimate pressure: 0.05 mbar
Power: 1/4 hp
Oil tank capacity: 170 ml
Dimensions: 243x114x207 mm
Weight: 6.5 kg

1415

Kit for vacuum pump faucet 1413

1413

Double stage rotary pump AV-12

Nominal displacement: 3,6 m^3/h @50 Hz
Pumping speed: 3,1 m^3/h @50 Hz
Ultimate pressure: 0,01 hPa(mbar)
Motor power: 0,12 Kw
Electric supply: 1ph ~ 220/240 V 50/60 Hz
Noise: 57 dB(A)
Weight: 6,5 Kg
Inlet dimension: 1/4"G
Oil filling: 0,3 Lt

AV-12

High vacuum silicone grease 6147

Tube pack 50 g.

6147

Oil refill for pumps 0069

500 ml.

0069

Rubber tube for vacuum pumps 0090

Dimensions: 7x17x1000 mm.

0090

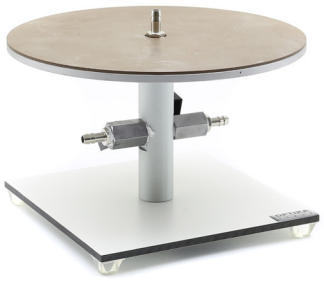
Bell jar 1069

It is made of very thick cast glass.
Dimensions: ø external 220 mm / internal 190 mm; h = 230 mm. The lower rim is frosted to have a perfect seal. Rubber cap with hook for electric bell.
To use with plate code 1068.

1069

Plate for bell jar 1068

This plate is made of metal with a perfect sealing.
Ø 250 mm.



1068

Vacuum bell with buzzer 1410

To show that acoustic waves do not propagate in a vacuum. For use with the pump code 1415 or code AV-12.

1410

Vacuum bell with plate 1402

Plate diameter: 20,5 cm.
Bell height: 19 cm.
To be used with a pump. It comes with a 1m vacuum hose. Resistance up to 1 bar.

1402

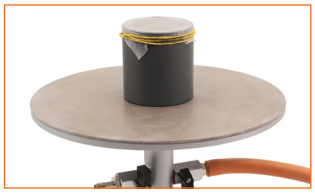
Electric bell 1074

For bell jar.
Powered by batteries.

1074

Pressure tear device 1072

The pressure tear device is made of PVC, with perfect seal.
It is supplied with its paper.



1072

Newton's tube (to be emptied) 1070

The tube is provided with stoppers and a tap and contains two objects of different masses and shapes.
It has to be connected to a vacuum pump. 1 meter long, made of glass.

1070

Magdeburg's hemispheres 1242

They are made of metal, with ground rims, supplied with rubber-holder so that they can be fitted to a vacuum pump through a rubber tube.
Diameter: 80 mm.

1242

Baroscope 1071

The baroscope demonstrates the Archimedes
push. In the air, the beam reaches the equilibrium, while in the vacuum it tilts on the balloon side, because the Archimedes push stops working.
It can be used with bell jar corde 1069.

1071

Torricelli's experiment apparatus 1043

It enables you to perform the classic Torricelli's experiment, thanks to the tube (length 85 cm, diametr 6 mm) with chemically carved millimetric division on the glass all along the interested part. It is supplied with base, basin, stands and funnel.
Mercury is not provided.

1043

Boyle Mariotte's Law apparatus 1414

A graduated cylinder made of transparent material is linked, at its bottom, to a manometer. Acting on the piston through a screw with hand-wheel, it is possible to reduce the volume of the air inside the cylinder and, at the same time, to read its pressure value on the manometer. The item is supplied with digital thermometer.

1414

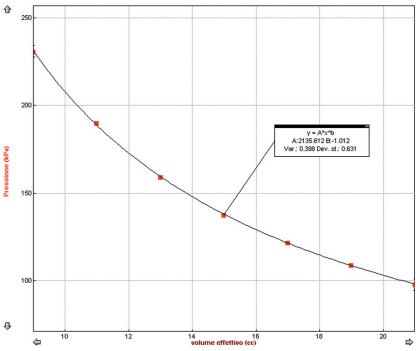
Device to study Boyle's Law 8216

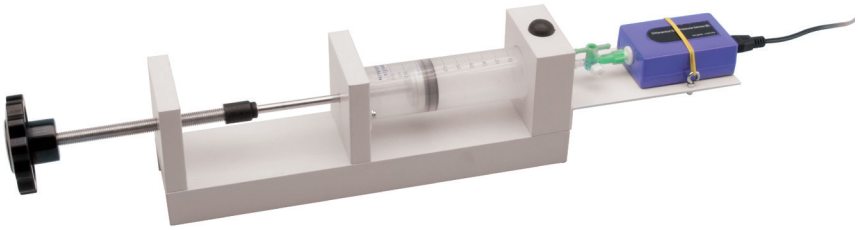
Thanks to this item it is possible to study quantitatively the isothermal conversions of gases. A transparent graduated cylinder is linked to a pressure sensor through a dual tap. Acting on the control knob the piston moves varying the volume of the air contained in the cylinder. Connecting the sensor to a real time data acquisition system it is possible to obtain the pressure Vs volume chart at a constant temperature.

Equipment for online use - not supplied

1 Interface code 9001
1 Pressure sensor code 9034
or
1 USB pressure sensor code 9069

Pressure graph according to volume, obtained point by point thanks to data acquisition system based on a PC. The interpolating curve approximates with precision the equation p V = cost.

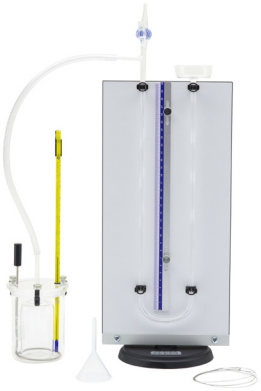




8216

Gay-Lussac's Law apparatus 1122

The Gay-Lussac's Law Apparatus allows us to verify the physics law that rules the pressure variation of a gas (at constant volume), as its temperature varies. The burner, the tripod and the wire gauze are sold separately.
The experiments can be performed using the temperature sensor (not supplied) Cod. 12903-00.



1122

Charles'Law apparatus 1137

The Charles Law Apparatus allows us to verify the physics law that rules the volume variations of a gas (at constant pressure) as its temperature varies. Therefore we can measure the dilatation coefficient (at constant pressure). The burner, the tripod and the wire gauze are sold separately.
The experiments can be performed using the temperature sensor (not supplied) Cod. 12903-00.

1137

Equipment for the verification of the laws of gases 1217

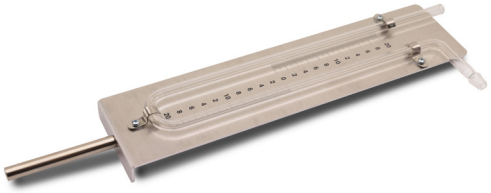
The kit for the verification of the laws of gases contains two devices - Charles' Law apparatus (code 1137) and Gay-Lussac's Law apparatus (code 1122).
The proposed experiments can be carried out using the temperature sensor (not supplied) Cod. 12903-00.

Saving on the items which are common to both devices, the price is more attractive than the sum of the two prices. Mercury is not provided.

1217

Free air manometers

Height 20 cm, without stopcock.	**1047**
Height 20 cm, with stopcock.	**1050**
Height 30 cm, with stopcock.	**1051**



1047 - 1050 - 1051

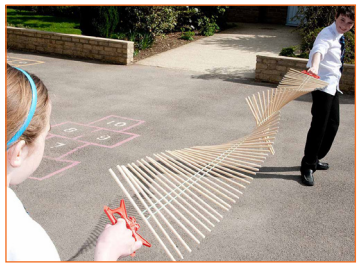
Set of 3 elastic strings 3011

To visualize the propagation of longitudinal and transversal impulses and their reflection and consequent creation of stationary waves.
This set includes:
1 elastic string Ø 4 mm, static length: 3 m, maximum extension length: 6 m.
1 coil spring Ø 10 mm, static length: 50 cm, maximum extension length: 5 m.
1 coil spring Ø 17 mm, static length: 50 cm, maximum extension length: 12 m.

3011

Device for the study of the waves 3006

With this simple device students can perform experiments on wave propagation and related phenomena. It is composed of an elastic rope with wood sleepers which visualize the vibratory state.

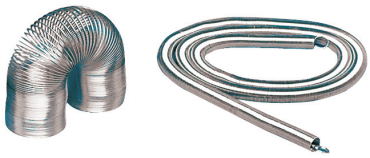


3006

Set of 2 coil springs (3025A+3025B) 3025

It is usefull to perform experiments on longitudinal and transversal waves' propagation, on the creation of stationary waves, on reflection and on other wave-related phenomena. Includes coil spring Slinky 3025A and coil spring 3025B.
Dimensions 1ª spring: Ø75x150 mm 2ª spring: Ø20x1900 mm.

Slinky spring Ø75 x 150 mm. 3025A
Coil spring Ø20 x 1900 mm. 3025B



3025 - 3025A - 3025B

Vibrator 3015

The vibrator should be used with the low frequence signal generator (code 5718), which is not supplied with this apparatus.
Height: 140 mm
Mass: 1 kg
Base diameter: 80 mm
Impedance: 8 Ω
Base height: 80 mm
Power: 10 W
Frequency range: 0-20 kHz

3015

Stationary wave apparatus 3014

The Stationary Waves Apparatus allows observation of the phenomenon of longitudinal and transversal stationary waves. The vibrator can be used with the low frequence signal generator (code 5718), which is not supplied with this apparatus.

Equipment supplied

1 Electromagnetic vibrator
1 Elastic string
1 Coil spring
1 80 mm rod with fixing thumbscrew
1 Table clamp with pulley
1 Rod with hook
1 Metallic rod 10 x 750 mm
1 Base
1 Bosshead
9 masses 10 g

3014

Kit to study stationary waves 3014.1

We recommend using the signal generator cod. 5718.

Equipment supplied

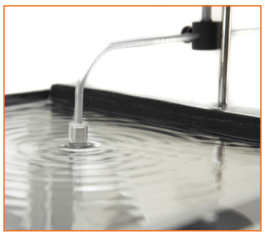
1 Vibrator
1 Elastic cord
1 Coil spring
1 80 mm rod
1 Table clamp with pulley
9 masses 10 g

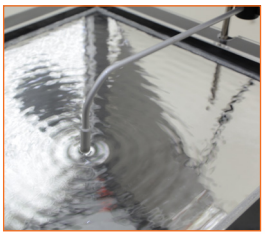
3014.1

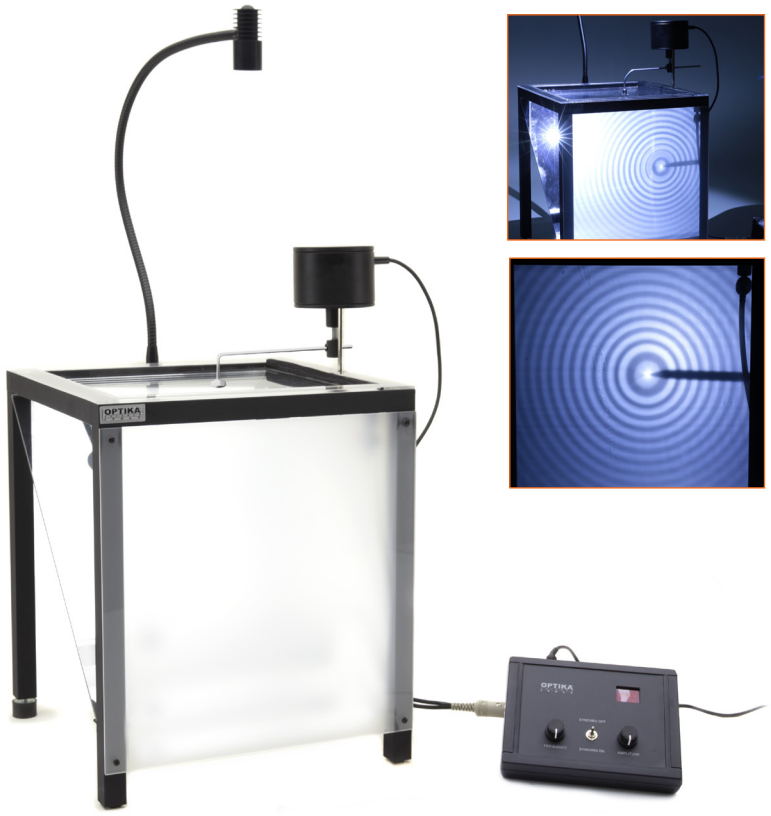
Ripple tank 3032

OPTIKA Ripple Tank has the following advantages:
-Simple to assemble
-Easy to carry out experiments
-Reliable and repeatable results
-Excellent visual resolution of the wave front

The stroboscopic lamp is fitted with an extra-bright 3W LED, which is synchronised with the surface wave generator. The control unit is equipped with a digital display and allows to set or to stop the synchronism of the vibrator with the lamp, the modulation of wave amplitude and its frequency. The vibrator is of an electro-dynamic type. The tank is provided with two adjustable feet and with an easy-to-use drain pipe ending with a tap.







Topics

- Superficial waves on water
- Wavefront
- Wavelength
- Propagation speed
- Reflection
- Refraction
- Interference
- Stationary waves
- Diffraction
- Huygens' principle

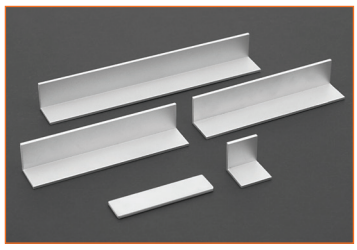
Equipment supplied

1 Ripple generator
1 Vibrator
3 Dipper
1 White LED
5 Barriers
3 Acrylic lens
1 Convex reflector

This ripple tank is delivered in a preformed polystyrene packaging.

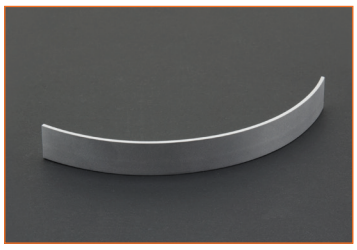
Barriers

For experiments on diffraction, reflection and for measuring wavelenght.



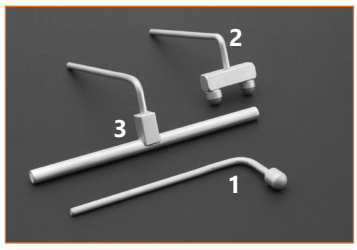
Convex Reflector

For extra experiments on reflection.



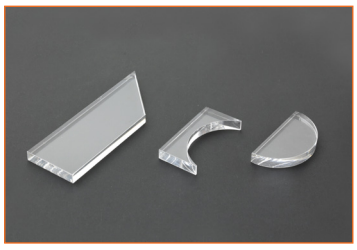
Dippers

1. Single Dipper
2. Double Dipper
3. Dipper for parallel waves



Acrylic Lens

Acrylic lens, convex
Acrylic lens, concave
Acrylic trapezium
For experiments on refraction.



3032

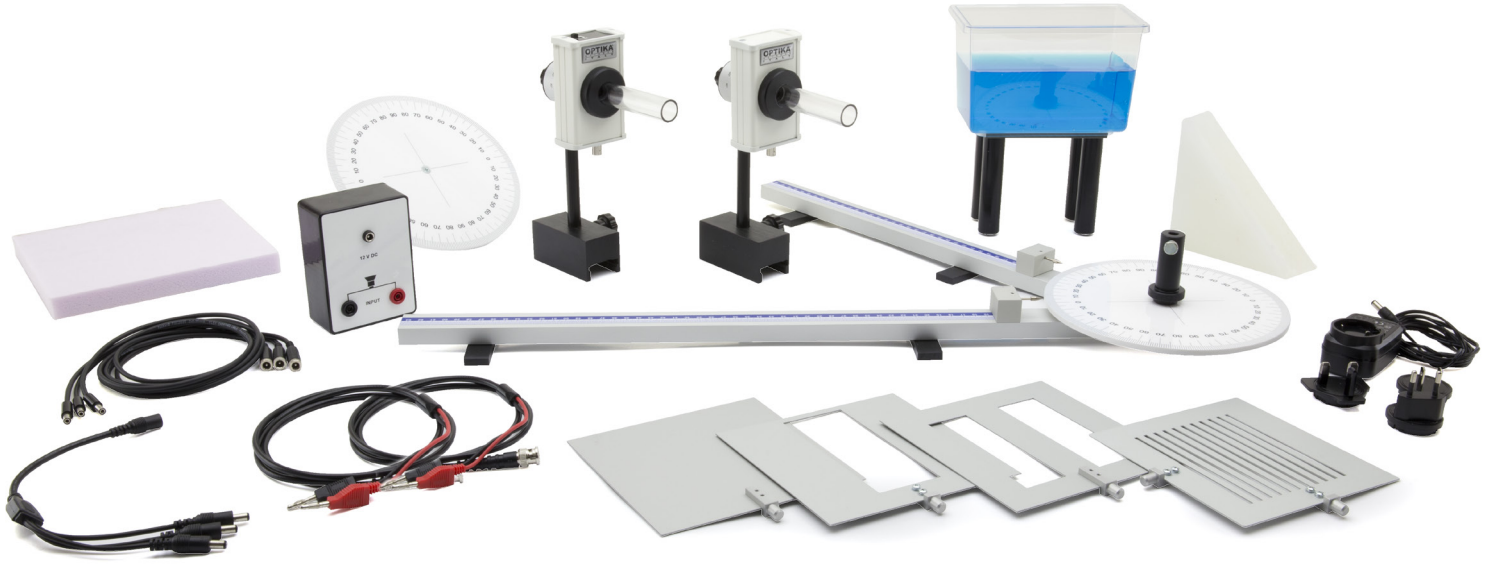
Trolley for ripple tank 3037

The truck is supplied with three drawers.

3037

Microwaves optics kit 5436

The microwave optics kit includes a transmitter, a receiver, a loudspeaker and other accessories that allow you to perform various experiences, through which you will discover how microwaves have the same characteristics as light waves and cause the same reflection, refraction and diffraction phenomena.
The presence of the protractor and the millimeter track and the ability to connect an oscilloscope Cod. 5195(not provided) to the BNC output of the receiver allow you to carry out a quantitative analysis as well.
The transmitter is equipped with a switch that allows you to choose between internal and external modulation of the carrier signal.

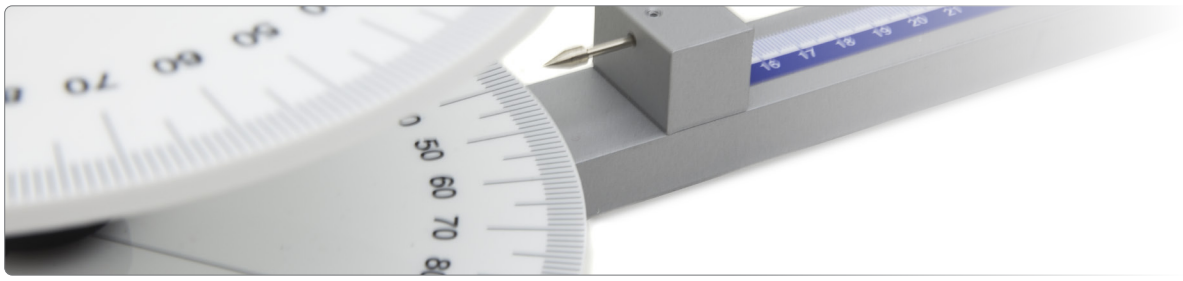


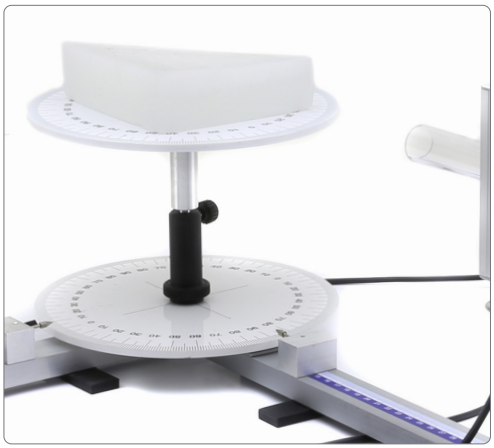
All the components shown in the picture are included.

Performable experiments

- Operational test
- Transmission and absorption by polystyrene body
- Transmission and absorption by water
- Transmission and absorption by the human body
- Transmission and absorption by a metal body
- Microwaves reflection
- Microwaves refraction
- Total reflection of the microwaves
- Microwaves polarization
- Microwaves polarization plane
- Diffraction due to a slit
- Diffraction due to a double slit (Young's experiment)

This microwaves kit includes one transmitter, one receiver and several accessories.
It is useful to study several experiments on microwaves:
it allows students to observe that microwaves have the same characteristics of light waves and they result in the same phenomena as
reflection, refraction and diffraction.



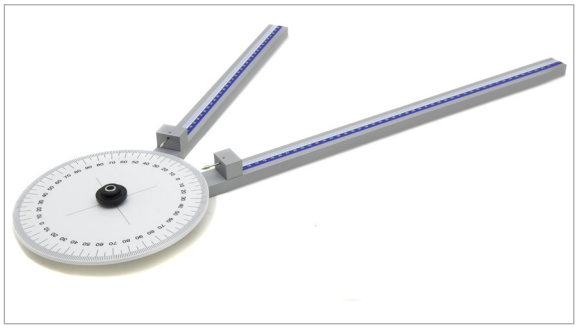


Transmitter
- power supply: 12 V - 1.5 A DC
- carrier wave frequency: 10.5 GHz
- wavelength: 2.85 cm
- switch between IM and EM
- BNC input

Internal modulation mode (IM)
- square wave
- modulation frequency: 676 Hz

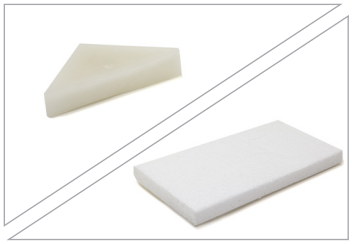
External modulation mode (EM)
- allowed frequency range: 100 Hz - 20 MHz
- max amplitude: 5 V peak to peak

Receiver
- power supply: 12 V - 1.5 A DC
- max operational distance: 1.5 m
- BNC output



Jointed bench
Microwave aluminium bench with two arms, respectively 500 mm and 650 mm long.
Provided with plate holder and protractor to perform quantitative measurements.

Paraffin prism
Useful to practice experiments on microwave refraction.

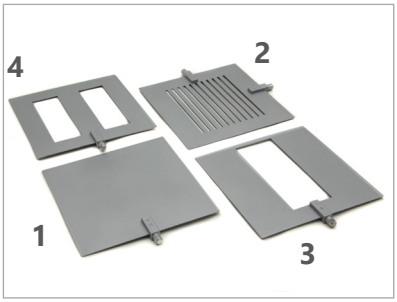


Polystyrene body
For experiments on microwave absorption.

Set of 4 metal plate

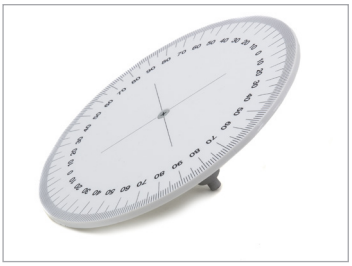
Dimension: 155x155 mm

1. Reflection plate
2. 11 slits grating plate
3. Single 50 mm slit plate
4. Double slit plate, single slit: 35 mm



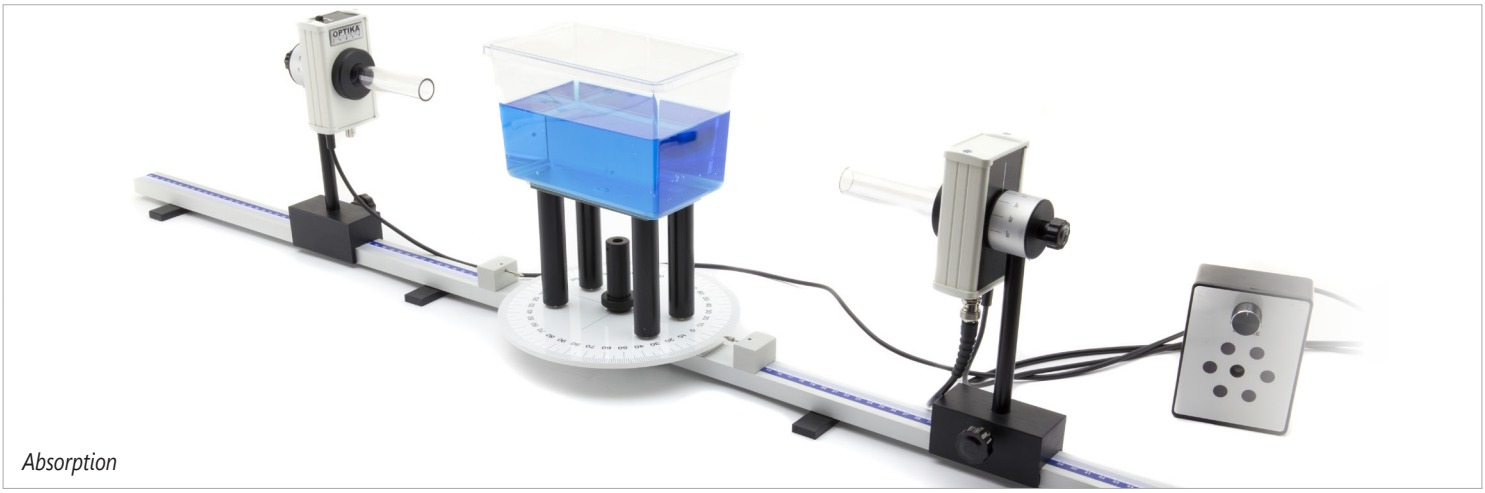
Protractor

With an accuracy of 1°.
The graduated scale is screen-printed on a polycarbonate plate for a simple and quick measurement reading.

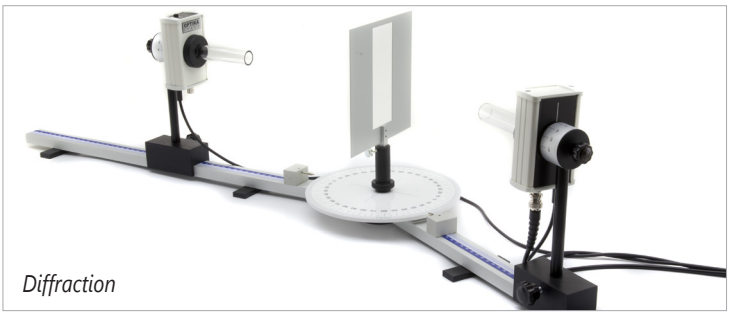


Water tank

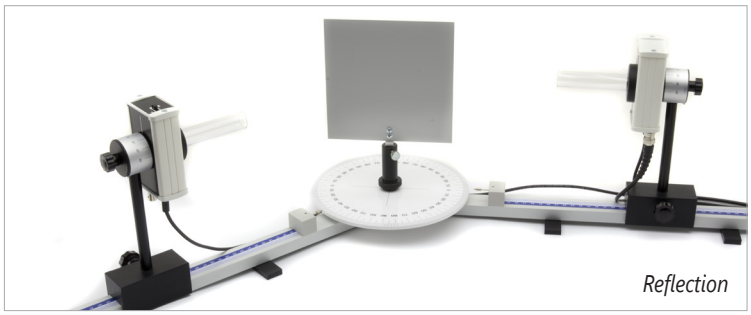
Useful to practice experiments on microwave absorption.



Absorption



Diffraction



Reflection

5436

Set of 8 tuning forks 3020

The items are made of chrome steel, with different length and section of 4.0x7.5 mm. Hz frequencies : 256(DO) - 288 (RE) - 320 (MI) - 341,3 (FA) -384 (SOL) - 426,6 (LA) - 480 (SI) - 512 (DO) Hz.
Suitable for demonstrating the tones-frequencies relationship.

3020

Tuning fork 3003

Oscillation frequency: 440 Hz. It is supplied with resonance box and hammer.

3003

Couple of tuning forks 3029

Oscillation frequency: 440 Hz. With resonance box, hammer and spare mass for beats.

3029

One-string metallic sonometer 3115

This instrument is composed of a single string, placed over a resonance box and fixed at both ends. The string is laid on an intermediate bridge which can be moved so that the sound reaches different frequencies.
The monochord was already used by Pythagoras in the 6th century B.C. to study acoustics.

3115

Vibrant bell 3002

The pendulums oscillate when the bell is hit with the hammer, thus demonstrating that the sound is generated by the bell's vibrations. Height 40 cm.

3002

Acoustic resonance apparatus 3010

By acting on the discharge tap of a tube full of water, it is possible to let the air column above the liquid enter in resonance with the tuning fork.

3010

Digital phonometer 3031

This instrument is easy-reading and it is particularly indicated for schools.
Range:
low values: 35 to 100 dB.
high values: 65 to 130 dB.
Resolution: 0,1 dB.
Accuracy: 1,5 dB.
Frequency: 31,5 to 8 kHz.
DC/AC output for external voltmeter.
With battery.

3031

2,5W, Loudspeaker 3017

Supplied with two bushings for the connection to the oscillationso generator code 3016 or 5718.
Impendance: 8 Ω.

3017

0,5W, Loudspeaker 3021

With stand (10 mm) in order to be housed on a base (code 0010). To be used with the oscillation generator code 3016 or 5718.
Impedance: 8 Ω.
Base not included.

3021

Piezoelectric microphone 3022

With stand (Ø 10 mm); predisposed to be linked to the amplifier. Base not included.

3022

Signal generator acoustic frequency 3016

Frequency field: 5Hz - 50 kHz on 4 ranges.
Variable amplitude continuously 0-8 V peak-to-peak.
Undistorted output power: 1 W (into 8Ω load). It is supplied with two 60 cm long cables.

3016

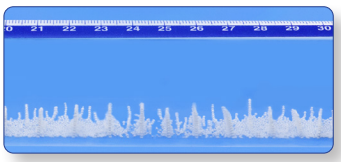
5W, Amplifier for code 3022 3114

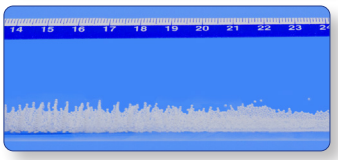
Power: 5W. You can use it also with loudspeakers code 3017 and code 3021

3114

Kundt's tube 3008

The incident acoustic wave interferes with the reflected one, creating the stationary waves. The polystyrene balls visualizes nodes and bellies, so making wavelength measurement possible. Now, knowing the frequency, you can measure the acoustic waves' speed in the air. The item is supplied with tube, stands and bases, piston and the polystyrene balls spreader. It must be used with a loudspeaker code 3017 and an oscillation generator code 5718 sold separately.





3008

Apparatus to measure acoustic waves' velocity in air 3034

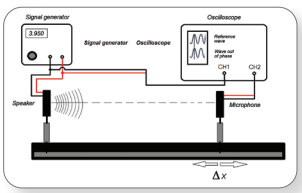
This equipment can measure the speed of sound measuring the displacement Δx between the loudspeaker and microphone to ensure that between the two waves, initially in phase, there is a delay time equal to the period of oscillation T or a multiple of T. The speaker is connected to the function generator that produces a sinusoidal signal of known frequency displayed on channel 1 of the oscilloscope. The output signal from the microphone receiver is instead displayed on the channel 2 of the oscilloscope. Changing the distance between the loudspeaker and microphone the two signals could be initially in phase. In practice, this is possible keeping the speaker fixed and moving the microphone, or vice-versa.

Equipment supplied

1 Bench 50 cm	1 Microphone with amplifier
2 Holders	2 Leads
1 Loudspeaker	2 BNC Leads

Equipment required, not supplied

1 Acoustic signals generator code 5718
1 Double traces oscilloscope code 5195



Using the bench you can measure the distance λ (wave length) at which the delay is a period T. So:

$$v = \frac{\lambda}{T}$$

3034

Crookes' radiometer HS7610

The radiometer's whirl starts to spin when exposed to a light source; the greater the intensity of the radiation, is the quicker it spins around. This fact is due to the gas particles inside the radiometer: when they hit the black sides of the whirl's paddles, which are warmer than the white sides because of a greater light-absorbent power, the particles bounce quicker and, therefore, give an impulse which is greater than the one given to the white sides. Thus the whirl's rotation is generated.

HS7610

Gases' kinetic model 2110

With this model it is possible to simulate the thermal temperature related movements of gases' particles. In the vertical cylinder there are very small balls agitated by a piston; the latter is linked to a vibrator with an electric motor (3-6 V) whose speed can be djusted.
It is provided without power supply.
The purchase of the power supply - code 4991 - is recommended.

2110

Ball and ring apparatus 2076

With the following experiment we can verify the thermal expansion of a metal.

2076

Bi-metallic strip 2062

Two foils fixed together, made of iron and copper, expand in different ways, causing the strip to bend.

2062

Ball and ring apparatus, with stand 2070

In order to prove the volumetric thermal expansion.
It can be used with the alcohol (or gas) burner.
Height: 30 cm.

2070

Dilatometer for liquids and gases 2137

With this simple apparatus it is possible to determine the thermal expansion coefficient of liquids and of air. The proposed experiments can be carried out using the temperature sensor (not supplied) Cod. 12903-00

2137

Precision linear expansion apparatus 2095

The precision linear expansion apparatus is provided with two metal hollow rods of different materials that are heated by the steam passing through them. The linear expansion of the different metals is measured using a dial gauge, while temperature is measured using a thermometer placed in contact with the rod.
In this way students can obtained all the information necessary to calculate the coefficient of linear thermal expansion.

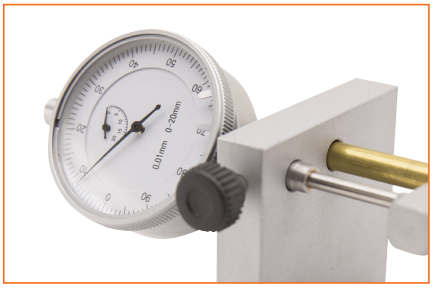
Equipment supplied

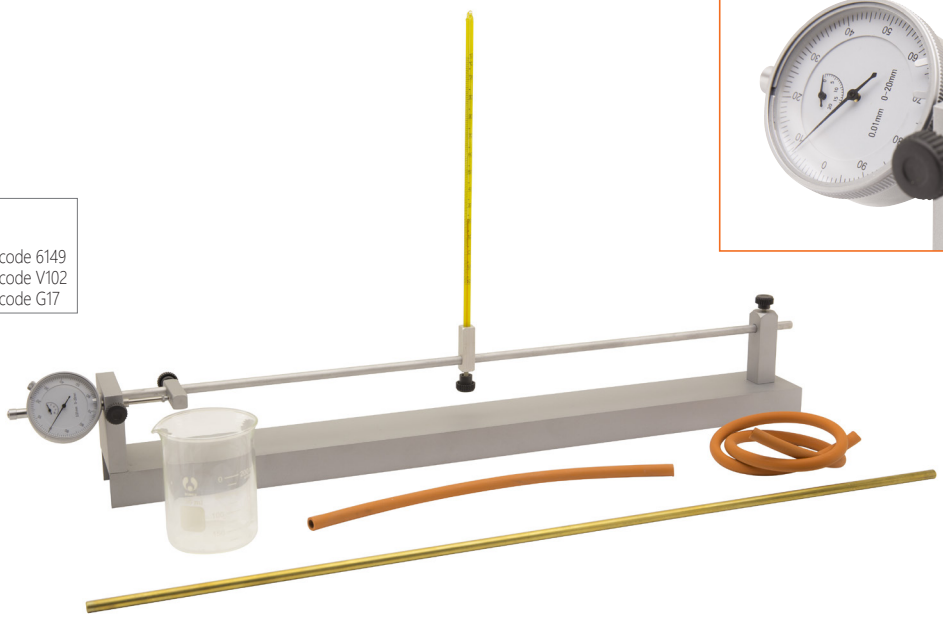
1 Linear expansion apparatus
1 Aluminum rod 700 mm
1 Brass rod 700 mm
1 Dial gauge 0-10 mm, 0.01 mm
1 Thermometer
1 Beaker
2 Silicone tube 50 cm

Equipment required, not supplied

Steam generator kit:

1 Heating plate	code 6149
1 Filtering flask	code V102
1 Rubber stopper	code G17





2095

Linear expansion apparatus 2046

To prove the thermal expansion of a bar. It works with cotton wads soaked in denatured alcohol and it is supplied with three rods: iron, brass and aluminium.
Dimensions: 30x13 cm.

2046

Specific heat kit 2030

It allows you to calculate the ratio between Q (heat supplied) and T (temperature increase). The proposed experiments can be carried out using the temperature sensor (not supplied) Cod. 12903-00.

Equipment supplied

1 Aluminium cylinder 800 g	1 Base
1 Copper cylinder 800 g	2 Insulated handles
1 Brass cylinder 800 g	1 Thermometer
1 Iron cylinder 800 g	1 Case
1 Electric heater 12V	

Equipment required, not supplied

1 Balance	1 Power supplier (max 3V; 2A cc)
1 Voltmeter	5 Leads
1 Ammeter	1 Stopwatch

2030

Set of 4 samples with equal volume 2036

For the measurement of specific heat through water calorimeter up to 350 ml. They are made of iron, brass, aluminium and PVC. Dimensions: Ø 20 mm. Height: 50 mm.

2036

Set of 4 samples with same mass 2087

For the measurement of specific heat through 1000 ml water calorimeter. They are made of iron, brass, aluminium and PVC. Mass about 500 gr.

2087

Electric calorimeter 200 ml 5283

The item is supplied with two stoppers; one stopper has an electric resistor. Maximum voltage: 6V. Supplied with thermometer and stirrer. Aluminium packaging. Capacity 200 ml. The proposed experiments can be carried out using the temperature sensor (not supplied) Cod. 12903-00.

5283

Thermoscope 4/T

It is suitable for experiments on the thermometer calibration. Length: 30 cm.

4T

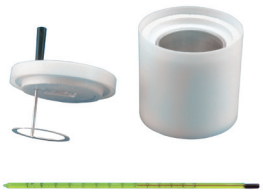
Thermal conductivity apparatus 2131

It is composed of 5 tubes, of different metals (aluminum, brass, copper, stainless steel, iron). If you heat the central cylinder on a flame, the pieces of wax placed at the ends of the tubes melt down at different times.

2131

Water calorimeter 350 ml 2099

This item is suitable for measuring the specific heat of solid and liquid samples. It is supplied with thermometer and stirrer. Plastic material packing. High thermal insulation. External dimensions: Ø130 mm, height 130 mm. Capacity: 350 ml. The proposed experiments can be carried out using the temperature sensor (not supplied) Cod. 12903-00.



2099

Water calorimeter 1000 ml 2056

Supplied with thermometer and stirrer and has double aluminium walls insulation from heat.
Dimensions: Ø 150 mm. Height: 150 mm.
The proposed experiments can be performed using the temperature sensor (not supplied) Cod. 12903-00.

2056

Electric calorimeter 350 ml 8201

Suitable for the verification of Joule's law; capacity 350 ml. It is supplied with two resistors you can use alone or in series. Maximum working voltage: 6V. Supplied with stirrer and thermometer. The proposed experiments can be performed using the temperature sensor (not supplied) Cod. 12903-00.

8201

Kit to study processes to achieve thermal equilibrium 8202

Through the use of two temperature sensors, this item lets you study how the transfer of heat occurs between two bodies, solids or liquids, with different initial temperature. As in each balance phenomenon, the warmer body gives heat to the colder body until the cancellation of the thermal difference. The Law, states that the temperature of the warmer body varies over the time is exponentially decreasing, while the Law according to which the temperature of the colder body increases is exponentially increasing. It is possible to establish an analogy with the water balance phenomenon and electric balance.

Topics

- Thermal equilibrium between two bodies with the same thermal capacity;
- Thermal equilibrium between two bodies with different thermal capacity.

Equipment supplied

1 Thermostatic container, capacity 350 ml
1 Alcohol thermometer
1 Hollow aluminium cylinder wire, mass 400 g
1 Aluminium cylinder to be inserted into the previous one , mass 400 g
1 Brass cylinder to be inserted into the hollow cylinder, mass 1000 g
2 PVC hose

Equipment required, not supplied

1 Heating plate code 6150 1 Balance

Equipment for online use - not supplied

1 Interface code 9001
2 Temperature sensor code 9061
or
2 USB Temperature sensor cod. 9085
or
2 Bluetooth Temperature sensor cod. 12903-00

Suitable to be used with sensors

8202

Heat dissipation kit 8206

With this kit and two temperature sensors (not supplied with this kit), it is possible to compare the different speeds at which two bodies with the same mass and the same initial temperature dissipate heat. The dissipation is quicker when the exposed surface is bigger and it is decelerated if the body is protected by a heat-insulating material.

Topics

- Study of a body cooling according to its thermal capacity;
- Study of a body cooling according to its surface;
- Study of a body cooling according to the difference of temperature compared to the environment;
- Study of a body cooling according to the interaction with the surrounding air.

Equipment supplied

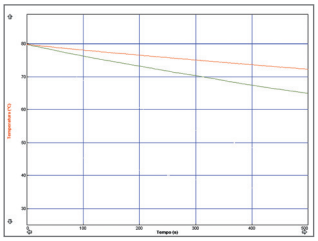
1 Brass cylinder with hook
2 Aluminium cylinders with hook
1 Aluminium thermal radiator
1 Insulating-material tube
1 Handle
1 Hardboard support plate

Equipment required, not supplied

1 Heating plate code 6150
1 Balance

Equipment for online use - not supplied

1 Interface code 9001
2 Temperature sensor code 9061
or
2 USB Temperature sensor cod. 9085



Cooling bend of two cylinders with the same size but made of different material: brass (red) and aluminum (green).

Suitable to be used with sensors

8206

Device to study thermal conductivity in solids 8203

The propagation of heat in solids occurs by conduction. The speed at which the heat spreads varies according to the substance. As regards metal, the speed is high while in other substances such as glass or plastic, it is very low. For this reason metals have been defined good conductors of heat.
Thermal conductivity can be studied thanks to this kit using three temperature sensors. An aluminium rod, a brass rod and a PVC rod, with a temperature sensor connected to each of them, are immersed simultaneously in a glass containing warm water. It is possible to observe the heat propagation speed difference between each rod.

Topics

- Comparison of the thermal conductivity of three different materials, both during heating and cooling;
- Comparison of thermal sensations and actual temperature measurements.

Equipment supplied

1 Beaker 400 ml with base
1 PVC disk with three holes
1 Aluminum rod
1 Brass rod
1 PVC rod

Equipment required, not supplied

1 Heating plate code 6150

Equipment for online use - not supplied

1 Interface code 9001
3 Temperature sensor code 9061
or
3 USB Temperature sensor cod. 9085

Suitable to be used with sensors

8203

Thermology kit 8212

Thanks to these items it is possible to perform some experiments related to thermal phenomena. For data collection and representation, 3 temperature sensors are enough. The real-time data acquisition system allows to obtain a graph of the temperature as a function of time during many thermal phenomena, which are essential to the Physics' program in secondary schools, for example, thermal balance, heat propagation, state changes, etc.

Topics

- Relation between heat and temperature
- Thermal equilibrium
- Thermal equilibrium
- Heat capacity in solids
- Cooling
- Thermal conductivity
- Greenhouse effect
- Evaporation
- Boiling
- The solidification and fusion.

Equipment supplied

1 Electrical calorimeter
4 Metallic samples
1 Kit for thermal balance
1 Kit for conductivity
1 Kit for cooling
1 Glass flask 250 ml
2 Rubber caps
1 Base
1 Metal rod
1 Clamp with clamp
1 Bottle of denatured alcohol
1 Glass tube
2 Lead cables
1 400 ml beaker
1 Bosshead
1 Thermometer -10 ° + 110 ° C

Equipment required, not supplied

1 Power supply
1 Heating plate
1 Electronic scale accuracy 1g
1 Table lamp 100 W
1 Timer
1 Distilled water
1 Sodium chloride
1 Vaseline oil

Equipment for online use - not supplied

1 Interface code 9001
3 Temperature sensor code 9061
or
3 USB Temperature sensor code 9085
or
3 Bluetooth Temperature sensor code 12903-00

Suitable to be used with sensors

8212

Gas thermometer 8209

In a gas thermometer, temperature readings are practically independent from the aeriform contained in the volume in which an isochoric process transformation (the variation in pressure and temperature at a constant volume) is produced if pressure and temperature conditions allow you to consider the aeriform used to be perfect. The kit consists of an aluminium container, with a capacity of about 330 cc, immersed in a glass container. Pressure and a temperature sensors allow you to characterize the system's evolution when it is heated or cooled. The straight line p = f (T) defined by the experimental data is the calibration curve of the air thermometer. The temperature value which is obtained extracting the graph up to the value p = 0, indicates that there is a temperature minimum value which is physically meaningful.

Topics

- Verifications of the Gay-Lussac Law
- Absolute zero
- The gas thermometer

Equipment supplied

1 Rubber tube
1 Beaker, 1000 ml
1 Base
1 Aluminium container with bung
1 Cover supporting the sensors

Equipment required, not supplied

1 Heating plate code 6150

Equipment for online use - not supplied

1 Interface code 9001
1 Temperature sensor code 9061
1 Pressure sensor code 9034
or
1 USB temperature sensor code 9085
1 USB pressure sensor code 9136

Suitable to be used with sensors

8209

Joule's effect apparatus 5711

It is a kind of electrical calorimeter with double transparent walls. It is possible to change the resistor without taking out the water. Working voltage:6V D.C. Resistors: 5 ; 10 Ohm. Capacity: 800ml.
The proposed experiments can be performed using the temperature sensor (not supplied) Cod. 12903-00.

5711

Apparatus for the measurement of the mechanical equivalent of heat (Callendar machine) 2055

This apparatus is composed of a 7 cm long brass calorimetric cylinder width 5 cm and supported by ball bearings. A copper ribbon is rolled around the cylinder and retained by a spring; a 5 kg weight hangs from it. Because of the friction between the ribbon and the cylinder during the rotation, the water inside the cylinder warms up. If you measure the work done and the heat produced, it is possible to determine the mechanical equivalent of heat.
The apparatus is supplied with boss-heads and 1/10 degree digital thermometer.

Questo cilindro calorimetrico, in ottone, può essere facilmente montato e smontato dal perno dell'apparecchiatura.

2055

Convection apparatus 2058

Glass spare part of code 2058 2058.1

This apparatus allows to see how heat transmission happens through convection, in liquids. Through the upper opening, you have to introduce into the tube a small amount of glitters (approx. 1 g) and then seed oil (approx. 150 ml, not supplied). By heating the bottom of the tube, it will be seen that glitters spread circularly. Alcohol burner to be purchased separately.

2058 - 2058.1

Absorbent and emitting powers apparatus 2031

It is supplied with 3 aluminium bodies.
One body is black-black, another is black-white and the last one is white-white.
If you expose them to the energetic flux of the light bulb, you can verify how the absorbent power and the emitting power depend on the colour of the surface.

2031

Kit to study radiation 8205

The heating of a body occurs when it is exposed to electromagnetic radiation, and it depends on its surface, on its mass and its absorption power. Exposing two disks, with different characteristics, at a radiation flow emitted by the same source (the sun, or simply a lamp – not supplied), it is possible to observe in real time the different temperature trend.

Topics

- Comparison between the absorption power of a disc with two polished faces and that of a disc with a polished face and a blackened face;
- Comparison between the absorption power of a disc with two polished faces and that of a disc with two blackened faces;
- Comparison between the absorption power of a disc with two blackened faces and that of a disc with a polished face and a blackened face;
- Verification of the irradiation Law as a function of distance.

Equipment supplied

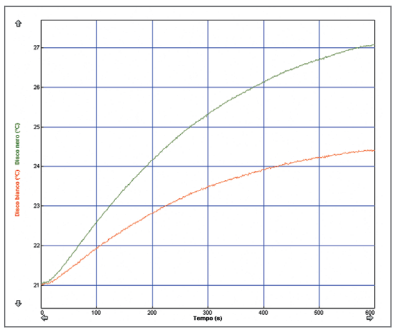
1 Platform with two adjustable supports	1 Aluminium disc with two blackened faces
1 Aluminium disc with two polished faces	1 Aluminium disc with a polished face and a blackened one

Equipment required, not supplied

1 Lamp 100 W

Equipment for online use - not supplied

1 Interface code 9001	or
2 Temperature sensor code 9061	2 USB temperature sensor code 9085



Two identical aluminium discs, a black-painted one and a polished one, are exposed to the light of a 100W lamp. A temperature sensor located on the discs demonstrates that the absorption coefficient of the black disc (green) is higher than the coefficient of the polished disc (red).

How to use the equipement

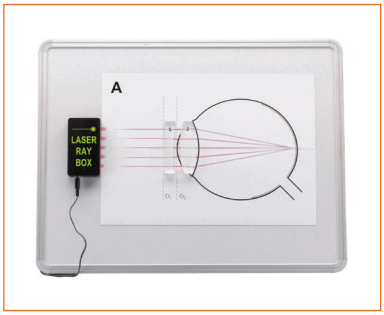
Suitable to be used with sensors

8205

Geometrical optics with pentalaser - version with magnetic board and red pentalaser 4095

These two collections allow very effective demonstrations of geometrical optics. They include a metallic board with back holder, a series of 6 magnetic plastic-coated tables with assembly schemes, a set of 3 mirrors, a series of 10 plexiglas optical bodies and a red pentalaser, all equipped with a power supply. Since the components are provided with a magnetic base, experiments can be made both horizontally (by students) and vertically (by teachers), taking advantage of the magnetic board.
Board dimensions: 45×60 cm.

10 feasible experiments

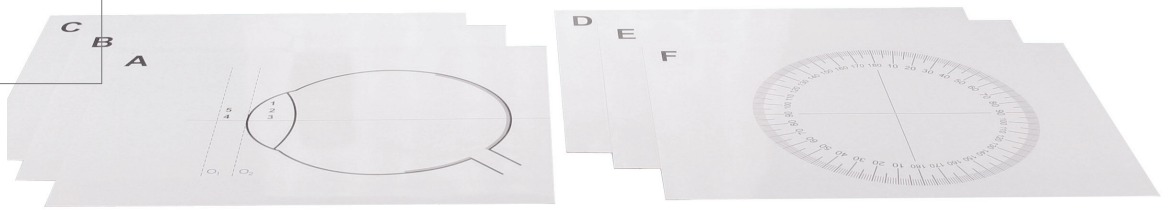


Topics

- Reflection and its laws
- Reflection in the concave spherical mirrors
- Reflection in the convex spherical mirrors
- Refraction and its laws
- Total reflection
- Refraction in the prisms
- Refraction in convex lenses
- Refraction in concave lenses
- Eye and its defects
- Optical instruments

Equipment supplied

1 5-Ray laser generator with power supply
1 Magnetic board
1 Plane mirror
1 Concave mirror
1 Convex mirror
1 Plate with parallel sides
1 Plane-cylindrical lens, diameter 150 mm
1 Plane-cylindrical lens, diameter 90 mm
1 Prism
4 Biconvex lenses
1 Biconcave lens
1 Plane-concave lens
6 Magnetic boards: A-B-C-D-E-F



4095

Geometrical optics kit with laser ray box 5607

Geometrical optics kit with laser ray box - Magnetic version with board 5609

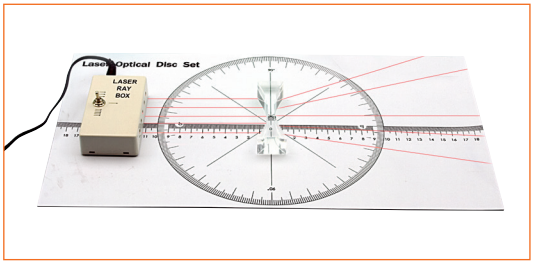
With this kit you can easily and quickly perform all basic geometrical optics experiments. The laser ray box is endowed with a switch which allows three different beam configurations (1-3-5). The high-quality optic bodies allow you to observe the trajectory of reflected and refracted beams. Because of its good quality/price ratio and because of the number and quality of possible experiments, this kit represents the best solution for geometrical optics experimentation for primary and secondary school.
Board dimensions: 45×60 cm.

Topics

- Pentalaser
- Reflection's laws
- The reflection in concave mirrors
- The reflection in convex mirrors
- Refraction's laws
- The refraction across a plate with plane and parallel faces
- The converging lenses' refraction
- The divergent lenses' refraction
- Measure of the liquid refraction index
- Total reflection
- Total reflecting prisms
- The periscope

Equipment supplied

1 Pentalaser with its power supply
1 Flexible mirror
1 Plate with plane and parallel faces
1 Semicircle lens
1 Converging lens
1 Diverging lens
1 Hollow semicircle
1 Rectangular prism
1 Trapezoidal prism
2 Rubber gloves
1 Cleaning cloth
1 Magnetic board (included only in code 5609)
1 Case



5607 - 5609

Red laser ray box 4328

The optic source is composed of 5 parallel laser. Through a smart solution, the light beams from the laser, which have circular section, are turned into linear section rays, i.e. into mono-frequency light blades; these light blades allow the performance of all main geometrical optics experiments.
A switch enable you to select different combinations, from 1 to 5 rays,in order to choose the most suitable configuration for the experiment.
Power supply included.

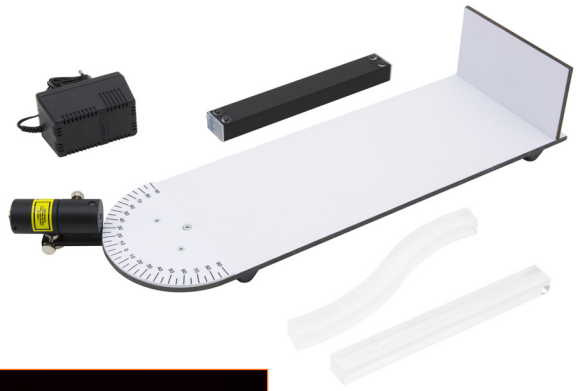
4328

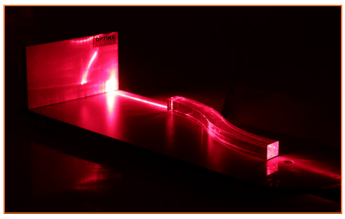
Optical fibre kit 4329

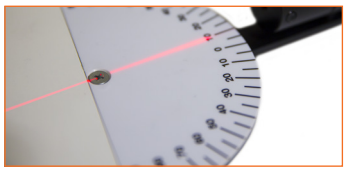
This educational model allows the observation of a wave guide's behaviour and the measurement of the numeric opening of an optical fibre as the refractive index of the mantle varies (air, water, alcohol).

Equipment supplied

1 Base with protractor and screen
1 Laser diode with turnable stand
1 Plexiglas basin
1 Plexiglas panel
1 Plexiglas curved silhouette







4329

Flat mirror 4077

It shows the simmetry of images.
Dimensions: 70x120 mm

4077

Optic prism 4032

The prism is made of a glass with a high refraction index, in order to show the phenomenon of white light's decomposition. Stand included. Dimensions: 10x2.5x2.5 cm.

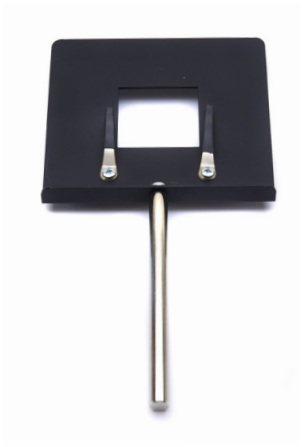
4032

Set of 6 glass lenses 4201

It shows the properties of different types of lenses: bi-convex, plane-convex, meniscus-converging, bi-concave, planediverging and meniscus-diverging. Lenses diameter:50 mm.

4201

Filter holder 4390



4390

Lens holder 4363

The item supports lenses and circular mirrors.

4363

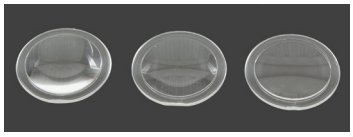
Concave and convex mirror 4061

Focus+/-10 cm. Diameter 5 cm
To be mounted on lens-holder code 4363.

4061

Set of 3 plexiglass lenses 4060

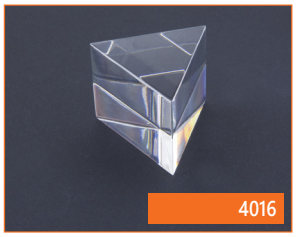
Focus +6, +10, -10 cm. Diameter 5 cm
To be mounted on lens-holder code 4363.

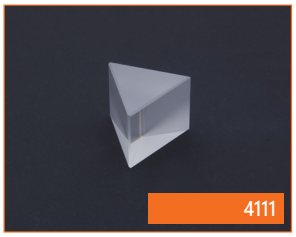


4060

Prisms

Plexiglass equilateral prism 40x40 mm	**4016**
Crown glass prism. Faces dimensions: 32x32 mm. Equilateral, n_D = 1,55	**4111**
Flint glass prism. Faces dimensions: 32x32 mm. Angle 60°, n_D = 1,67	**4112**
Hollow equilateral prism: The item allows the performance of experiments on refractometry of liquids. Sides dimensions and height: 45 mm.	**4144**





Set of 7 optical bodies 4158

Equipment supplied

- 1 Trapezoidal prism
- 1 Rectangular Prism
- 1 Adjustable concave-convex mirror
- 1 Bi-concave lens
- 1 Isosceles prism 45°-45°-90°
- 1 Semi-circular prism
- 1 Bi-convex lens
- 1 Protractor

4158

LED light source 4361

This projector has a white LED as a light source. It comes with a power supply. Base not included (hole Ø 10 mm).

4361

Solar Focometer 4357

This device allows easy and accurate measurement of the focal length of converging and diverging lenses, taking advantage of solar radiations.

4357

Projector of optical rays and color mixer 4129

This fundamental item for the study of light phenomena, is composed of a rectangular case (175x90x55 mm) containing a lamp with vertical filament (12V - 36W) placed in the upper part. A system of cylindrical converging lenses enables you to obtain converging, diverging or parallel light beams.
On the front of the case there are three windows with clasps, whose internal part are mirror-like and endowed with guides for inserting diaphragms and other colour filters. All equipment is contained in a plastic case. Power-unit included.

Topics

- Law of reflection
- Refraction in diverging lenses
- Reflection in mirrors
- Refraction in prisms
- Laws of refraction
- Dispersion of white light
- Total reflection
- Filters
- Refraction in a plate
- Primary and secondary colours
- Refraction in converging lenses
- Colour composition

4129

Digital luxmeter 4125

To measure illuminance.
Digital 4-colour LCD display.
Measurement range: 0 ~ 200kLux, 0 ~ 20kFc.
Resolution: <1000:0,1 >1000:1.
Accuracy: ± 3% reading ± 8 digits (<10,000 lux).
± 4% reading ± 10 digits (>10,000 lux).
Temperature range: -20°C ~ 70°C.
Temperature accuracy: ± 1.5°C/2.7°C.
Power supply: 3x1.5V AAA batteries.

4125

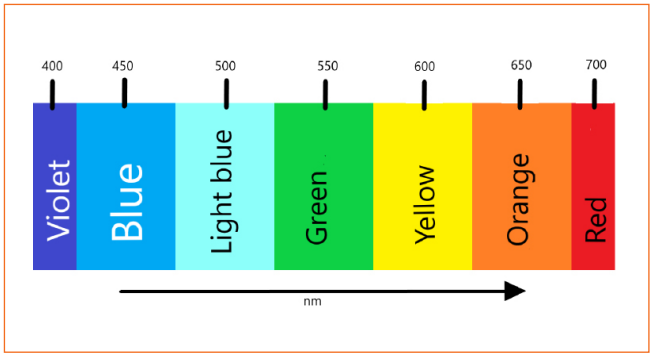
The principle of digital imaging 5335

This instrument is thought for experimenting and carrying out measurements on what physically lies at the basis of the digital imaging.
The main objective is to understand, also quantitatively, the connection between the digital features
and the physical quantities involved in the coloring menaging of a PIXEL, that is the unit of the digital imaging.

Dimensions:
188.5x133.5x76.5 cm

Topics:

- LIGHT. Fundamental Properties
- ADDITIVE COLOR THEORY. WHY and HOW?
- LEDs. What are they? How do they work?
- RGB LANGUAGE. Connection between Digital and Physical worlds
- ELECTRONICS. What happens into the Circuit?
- PIXEL. So simple now!



5335

Hand Newton's disk 4048

If the cranck handle is spined, the disk looks
like it's white because of the
light recombination.
Disk diameter: 17 cm.

4048

Electric Newton's disk 4200

The item is linked to an electric motor which is powered by voltage
of 6 Vdc. It is supplied with 5 disks to show the additive colour synthesis. Power
supply not included.

4200

Transparent coloured spades 4135

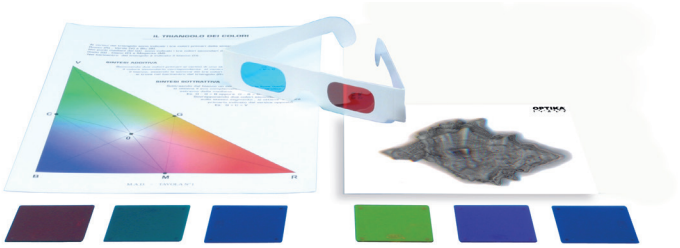
Six different colours. Superimposing the spades and exposing them to a light source, it is possible to learn the concept of primary and secondary colours.

4135

Colours and vision Kit 4015

Equipment supplied

1 Set of 3 primary colour filters;
1 Set of 3 secondary colour filters;
1 Chart with colour triangle;
1 Chart with stereoscopic figure
1 Pair of stereoscopic spectacles



4015

Disks for Newton's rings 4116

Couple of glass disks; one has plane, parallel faces; the other has a slightly spherical curve. They are superimposed so to produce Newton interference rings, which are monochromatic if you use laser light and become coloured if you use white light. Disk diameter: 55 mm.

4116

Additive colour synthesis apparatus 4352

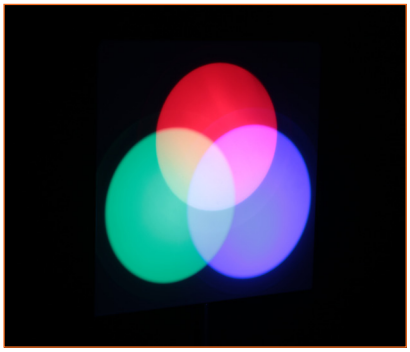
With this apparatus it is possible to perform the additive colour synthesis of the primary colours : red, green and blue. The apparatus is composed of 3 led projector, whose intensity can be changed with continuity. In this way it is possible to obtain the white colour and all the other colours of the colour triangle.

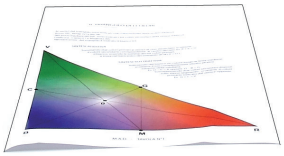
Topics

- Binary colour synthesis
- Complementary colours
- The trichromatic coordinates
- Colour triangle
- Colour reproduction

Equipment supplied

3 led projector: red, green, blue
1 Stand
1 Power-unit
1 Tripod base
1 White screen
1 Colour triangle chart





4352

Fresnel's double prism 4115

Double prism with very small refractive angle, obtained from a whole block of glass. Insert it in a thin light beam and it refracts the beam's two halves, superimposing them to generate interference fringes.

4115

Red diode laser device with magnetic base and lens 4354

This continuous emission laser device is supplied with a lens to obtain a linear ray of light. Moreover base and battery-holder are supplied with magnets in order to be applied to a magnetic blackboard.
Wavelength : approx. 635 nm.
Power: 1mW.

4354

Diaphragm with 1 slit 4104

On a frame 50x50 mm, to be mounted on filter-holder code 4390.
Slit width: 0.1 mm.

4104

Diaphragm with 2 slits 4105

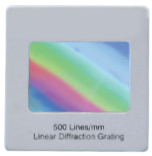
On a frame 50x50 mm, to be mounted on filter-holder code 4390.
Slit width: 0.1 mm.

4105

Diaphragm gratings

On a frame 50x50 mm, to be mounted on filter-holder code 4390.

80 lines/mm	4106
500 lines/mm.	4212
1000 lines/mm.	4213



4106 - 4212 - 4213

Set of 3 diffraction gratings 4143

100 Lines/mm
300 Lines/mm
600 Lines/mm

4143

Red diode laser device with stand 4207

Continuous emission device with power-unit.
Visible up to 35 m; power: < 1 mW; wavelength : 635 nm.
It is supplied with a removable lens which is able to turn the circular section of the ray into a linear one.
Jointed stand diameter: 10 mm.
Supplied with base and transformer.

4207

Green diode laser device with stand 4151

It has a continuous emission; power-unit included.
Power: 3mW; wavelength: 532 mm.
It is supplied with a lens to obtain a linear trace.
Adjustable stand diameter: 10mm.
Supplied with base and transformer.

4151

Kirchoff-Bunsen's spectroscope 4028

The item is mounted on a circular metal platform, it is composed of: 1 collector with adjustable slit, 1 collector with graduated scale and 1 collimator with 2 interchangeable eyepieces. The slit of the collector is supplied with a small prism which allows you to compare the spectrum of two different sources. While the collector, equipped with achromatic objective, is fixed to the platform, the collimator can rotate on an alidade, keeping the directional axis in the centre of the apparatus. The collector with graduated scale requires a small white light source to project the image of the scale in the eyepiece of the collimator by means of the reflection on a face of the prism. The equilateral prism made of highly dispersive material. With this device you can study the spectrum of a source of monochromatic or polychromatic light. We recommend the use of interferential filters to the check of the wavelength.

4028

Spectrometer 4209

This instrument has very good optic and mechanical features which allow the exact measurement of the optical ray deviation angles; therefore it can determine the refractive index of solids and liquids and the wavelength of monochromatic sources.
Base: made of firevarnished cast-iron. Goniometer: Ø 17.5 cm and divided in 360° with a precision of 1°.
It is equipped with a vernier, which allows to measure with an accuracy of 1/10°.
Telescope: it has achromatic objectives with an 178 mm focal length and an eyepiece 15x. Focusing allows fine regulation.
Collimator: endowed with achromatic objective with 178mm focal length and with a steady adjustable slit up to 6 mm.
Plane of the prism: it can be adjusted both vertically and horizontally and it is supplied with boss-heads for the fixing of the diffraction grating. Diameter: 80 mm. Equipment: 1 Crown glass equilateral prism 32x32 mm; 1 diffraction grating 500 lines/mm; 1 magnifying lens.
Dimensions: 48x33x33h cm. Weight: 1,2 Kg.
The purchase of the diffraction gratings 80 lines/mm and 1000 lines/mm is suggested to verify the variation of the spectral resolution.

4209

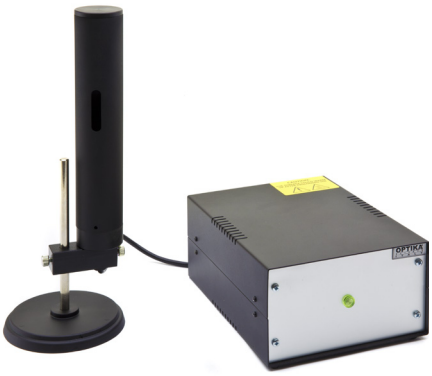
Light source for spectroscope 4326

When the item is placed in front of a tube with graduated scale, it illuminates the scale , thus allowing the operator to read the wavelength of the spectrum rows. The base is sold separately (code 0010).

4326

E27 Spectrum lamps holder with power unit 4035

The item is composed of a lamp-holder with lamp-shade, whose height is adjustable in order to allow a perfect allignment with the collimator of the spectroscope. Power supply is provided.



4035

Spectrum lamp 8 PIN

These lamps are the most convenient light source for spectroscopy.

Mercury spectrum lamp	**4054**
Sodium spectrum lamp	**4056**

4054 - 4056

Spectral lamps E27 connections

To be used with lamp holder/power supply cod. 4035

He (helium) spectral lamp E27	**4173**
Hg (mercury) spectral lamp E27	**4174**
Spectral lamp Na (sodium) E27	**4176**
Spectral lamp Ne (neon) E27	**4177**

4173 - 4174 - 4176 - 4177

Spectrum tubes power unit 4337

Power-unit able to provide electric high voltage, in order to use all spectrum tubes.
Power supply: 220V.
To be used: 30 s on and 30 s off.

4337

Spectrum tubes 4337

Oxygen	**4338**	Water vapour	**4342**	Hydrogen	**4346**
Carbon dioxide	**4339**	Nitrogen	**4343**	Mercury	**4348**
Air	**4340**	Neon	**4344**	Iodine	**4349**
Helium	**4341**	Argon	**4345**	Kripton	**4350**

4338 - 4339 - 4340 - 4341 - 4342 - 4343 - 4344 - 4345 - 4346 - 4348 - 4349 - 4350

Spectrum tubes kit, with power unit 4123

This kit is composed of the power-unit code 4337 and of 12 spectrum tubes previously described. (codes 4338, 4339, 4340, 4342, 4344, 4346, 4348, 4341, 4343, 4345, 4349, 4350).

4123

Kit for spectral analysis 4120

This set has been designed to allow students to practice the emission spectroscopic analysis.

Equipment supplied

1 Portable spectroscope
10 Needles
1 Bottle of sodium chloride
1 Bottle of potassium chloride
1 Bottle of strontium chloride
1 Bottle of copper chloride
1 Bottle of barium chloride
1 Bottle of sodium nitrate
1 Bottle of potassium nitrate
1 Bottle of strontium nitrate
1 Bottle of copper nitrate
1 Bottle of barium carbonate

4120

Ni-Cr string for spectral analysis 6107

Glass handle.
Wire length: 6-7 cm.

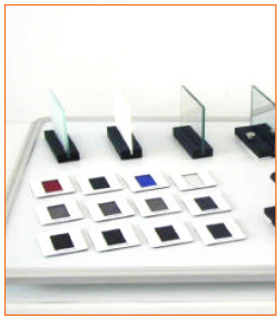
6107

Wave optics kit 4327

A coherent light source (diode laser divice) is exploited to show the priciples of the wave optics: polarization; interference; diffraction and holografy. Components are endowed with a magnetic base, in order to be placed safely on a magnetic whiteboard (included).

Topics

- Light's interference
- Interference on a thin plate
- Michelson's interferometer
- Light diffraction
- Circular hole diffraction
- Squared hole diffraction
- Diffraction grating
- Holography
- Light polarization
- Light absorption



4327

Light diffusion kit 4336

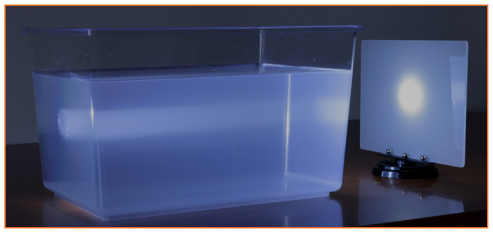
Why is the sky blue at midday while it turns red at sunset? When the light passes through particles with comparable size of the light's wavelength, light diffusion (elastic scattering) takes place.
The molecules in the air have a size comparable to the wavelength of blue component of the light.
Consequently, the molecules scatter blue light from the sun much more efficiently than the other components. For this reason, our eyes see the blue sky.
On the contrary, at sunset, light passes through a larger layer of the atmosphere and it goes through many solid particles (dust) that scatter the red component of the sun rays. With this kit, you can observe on a screen the phenomenon of progressive diffusion. With the polarizing filter it is also possible to study the polarization of the diffused light. The optic projector must be bought separately.

Equipment supplied

1 Dropper
1 Polarizing filter
1 Semi-transparent screen
1 Glass stirrer
1 Basin

Equipment required, not supplied

1 LED projector
1 Base
Milk



4336

Basic optical bench 4203

9 feasible experiments

Topics

- Dioptric projector
- Rectilinear propagation of light
- Reflection of light into spherical mirrors
- Lenses
- Images in spherical mirrors
- Images in converging lenses
- Conjugate points of converging lenses
- The eye and its defects
- Correction of the eye defects

Equipment supplied

1 Optical bench 2 mt	2 Lens holders
4 Holders	2 Aluminium rods
1 LED projector with power supply	1 Concave mirror +10
1 Set of 6 glass lenses	1 Convex mirror -10
1 White screen	1 Box

4203

Small optical bench 4202

29 feasible experiments

Topics

- Dioptric projector
- Rectilinear propagation of light
- Eclipses
- Moon phases
- Lighting law
- Diffusion of light
- Reflection of light
- Reflection of light into spherical mirrors
- Refraction of light
- Refractive index and the colours of light
- Total reflection
- Refraction of light through a prism
- Dispersion of the white light
- Lenses
- Images in flat mirrors
- Images in spherical mirrors
- Conjugate points of spherical mirrors
- Images in converging lenses
- Conjugate points of converging lenses
- The eye and its defects
- Correcting eye defects
- The compound microscope
- The slide projector

Equipment supplied

1 Linear ruler	1 Convex mirror - 10
1 Equilateral prism	1 Optical bench 90 cm
1 Red filter	1 Optical projector LED 6V
1 Green filter	1 Lamp
1 Blue filter	1 Earth-Moon system
1 Semi transparent screen	1 Lens +6 cm with lens holder rod
1 Slide 50x50	1 Lens +10 cm with lens holder rod
1 Plexiglas semi cylinder	1 Lens -10 cm with lens holder rod
1 Screen with squared hole	1 Protractor
1 Plane mirror	1 Filter holder
1 Small plane mirror	1 White screen
1 Isosceles prism	1 Microscope slide with holder
3 Holders	1 Square ruler
1 Holder for the projector	1 Beaker
1 Concave mirror + 10	1 Box

4202

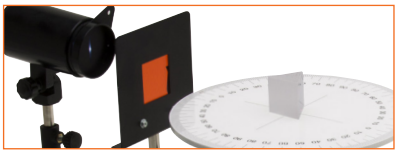
120 cm wave and geometrical optics bench 4080

With this optical bench, the teacher can perform a great number of quantitative and qualitative experiments on both geometrical and undulating aspects of optic waves. This bench is a necessary educational instrument in order to make a lesson a real moment of union between theory and experimental reality, and this is because of the quickness of its assembly and the ease in performing the experiments.

25 feasible experiments

Topics

- Rectilinear propagation of optical waves
- Lunar and solar eclipse
- Light scattering
- Radiation law
- Reflection laws
- Reflection in spherical mirrors
- Images in spherical mirrors
- Refraction laws
- Total internal reflection
- Refraction through a prism
- Refraction through lenses
- Images in lenses
- The eye and its imperfections
- Optical instruments
- The diode laser
- Diffraction through a hole
- Diffraction through a slit
- Measuring the wavelength of a laser
- Interference of light
- Interference according to Young
- Measurement of a wavelength with Young's method
- Diffraction grating
- Measurement of a wavelength with a grating
- Measuring the wavelength of white light
- Linear polarization
- Polarized light
- Natural rotatory power



Equipment supplied

1 Linear ruler	1 Diaphragm with 1 slit	1 Earth – Moon system
1 Red filter	1 Diaphragm with 2 slits	1 Adjustable slit
1 Green filter	1 Crown glass optical prism	1 Horizontal goniometer
1 Blue filter	1 Red diode laser with 3V power supply	1 Lens +6 cm with lens holder
1 Semitransparent glass	4 Holder	1 Lens +10 with lens holder
1 Slide	1 Projector holder	1 Lens -10 with lens holder
1 Plexiglas semicylinder	1 Sphere with stem diam. 30 mm	1 Filter holder
1 Diaphragm with square hole	1 Double spherical mirror +10	1 Microscope slide with holder
1 Plane mirror	1 Optical bench 120 cm	1 Grating 500 lines/mm
1 Double symmetrical arc	1 LED projector with 6V power supply	1 Square ruler
1 Rectangular isosceles prism	1 White screen with graduated scale	1 Beaker
1 Diaphragm with hole 2 mm	1 Pair of polarizers	1 Box
1 Diaphragm with hole 0,4 mm	1 Polarimetric tube	
1 Diaphragm with hole 0,2 mm	1 Punctiform bulb	

4080

90 cm Optical bench to study diffraction 8403

The optical bench allows you to study qualitatively and quantitatively the phenomena of diffraction.

A beam of laser light is directed on a revolving support which has some splits, holes and openings. The diffraction figures which are formed are collected by a light sensor which is in line with the linear position sensor. Moving the sensor horizontally with a handle, you will get a voltage which is proportional to the light intensity related to the position of the light sensor.

Connecting the outputs of the two sensors to a data acquisition system, it is possible to obtain the curves that show how the light intensity varies according to the position. Knowing the geometrical features of the openings and holes and evaluating the distance between the diaphragm and the light sensor, it is possible to quantitatively verify these phenomena.

Topics

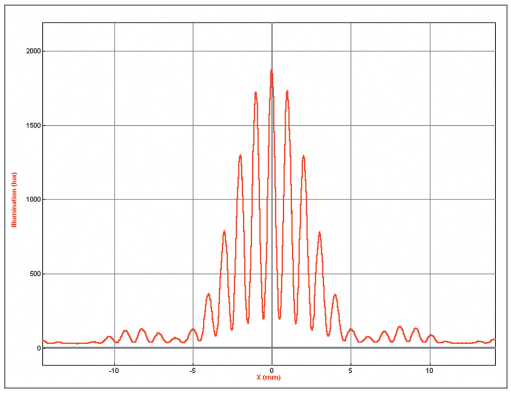
- Diffraction phenomena
- Interference phenomena

Equipment supplied

1 Optical bench provided with brightness sensor and potentiometer for linear position
1 High quality diode laser
1 Power supply for diode laser
1 Support with laser holder
2 Set of revolver diaphragms with slots of different size
1 Support for disk with slots (to place directly on the laser source)
1 White screen
1 Support for white screen
2 Cables for brightness and potentiometer sensors
2 Sensor adapters

Equipment for online use - not supplied

1 Interface code 9001
1 Adapter code 9058



The graph illustrated above was obtained directing the laser ray on a dual slit. It clearly shows the overlap of two wave phenomena: the Young interference produced by the two slits and the diffraction generated by each slit. Also in this case it is possible to check the relation which provides the distance from the center of the secondary maximums and minimums.

Suitable to be used with sensors

8403

Modular Optical Benches

100 cm, optical bench	**4401**
150 cm, optical bench	**4402**
200 cm, optical bench	**4404**

Thanks to this modular system it is possible to choose between benches of different lengths. It is also possible to connect a joint extension of 50cm to each of them: this is very useful to perform optical experiments where the optical beam, due to the effect of reflection or refraction, comes out from the main axis of the bench.
Thanks to these optical benches, the teacher can perform a large number of experiments on optics core topics. To satisfy teaching needs, we offer various accessories to complete your own optical bench.

4401 - 4402 - 4404

Optical Bench Extension 50cm 4362

4362

LED Light Source 4361

4361

Green Diode Laser 4151

Power: 3 mW
λ: 532 nm

4151

Red Diode Laser 4207

Power: 1 mW
λ: 635 nm

4207

Punctiform Lamp 4376

4376

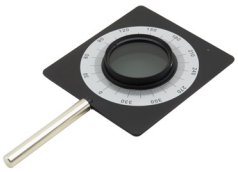
Lens Holder 4363

4363

Filter Holder 4390

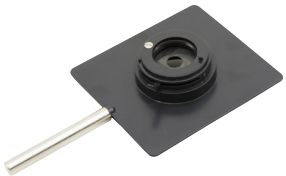
4390

Couple of Polarizing Filters 4370



4370

Iris diaphragm 4375



4375

Adjustable slit 4380

4380

Earth-Moon system 4377

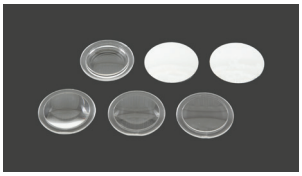
4377

Holder 4301

4301

Set of lenses and mirrors 4381

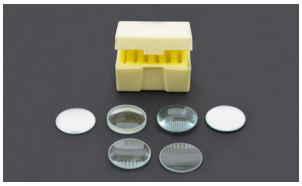
Plexiglass lenses



4381

Set of lenses and mirrors 4382

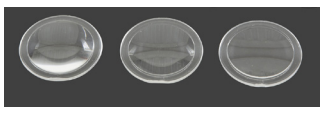
Glass lenses, mirrors with box.



4382

Set of three lenses 4060

Plexiglass lenses.



4060

Mirrors 4061

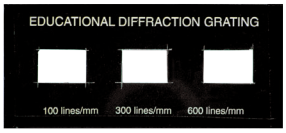
Concave and convex.

4061

Microscope slide 4393
With support.
Honey bee, hind leg.

4393

3 Diffraction Gratings 4143
100/300/600 lines/mm.

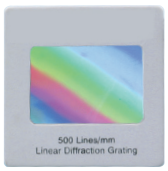


4143

Diffraction Grating 4106
80 lines/mm.

4106

Diffraction Grating 4212
500 lines/mm.



4212

Diffraction Grating 4213
1000 lines/mm.

4213

1 Slit Slide 4104

4104

2 Slits Slide 4105

4105

Primary colours filters 4168
Blue, green and red.

4168

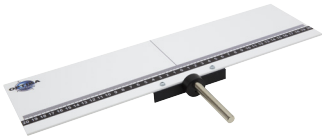
Secondary colours filters 4169
Cyan, yellow and magenta.

4169

Plexiglas screen 4365

4365

Screen with ruler 4366
36 mm, millimeter scale.



4366

Screen Support 4367

4367

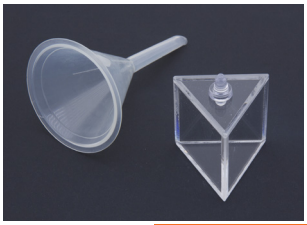
Horizontal Goniometer 4383

4383

Set of 7 Optical Bodies (glass) 4158

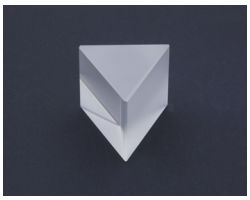
4158

Hollow Equilateral Prism 4144



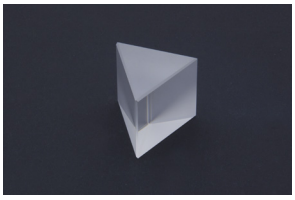
4144

Flint Glass Prism 4112



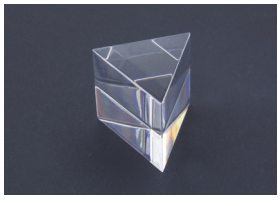
4112

Crown Glass Prism 4111



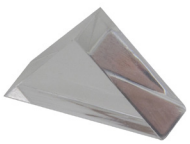
4111

Equilateral Prisms 4016
Plexiglass made.



4016

Rectangular Isosceles Prism 4072



4072

Semicylinder 4025
Plexiglass made.

4025

Polarimetric Tube 4371

4371

Optical bench lux meter 4374

4374

Friction rods

Hard rubber rod. Diameter 12mm length 25mm.	**5139**
Plexiglas rod. Diameter 12mm length 25mm.	**5002**
PVC rod. Diameter 12mm length 25mm	**5003**
Glass rod. Diameter 12mm length 25mm.	**5058**

5139 - 5002 - 5003 - 5058

Set of 5 friction rods 5348

The set is composed of 5 electrifiable rods: plexiglas, nylon, hard rubber, glass, hard rubber-brass. With wool cloth, silk cloth and rod stand.
Diameter 12 mm length 25 mm.

5348

Electroscope 5280

If you bring an electrified body near the plate of the instrument, the leaf diverges because of the electrostatic repulsion with the rigid stand. With graduated scale. 12,5 x 7,5 cm, h 17 cm

5280

Double electric pendulum 5090

If you bring an electrified body near the instrument, its two balls diverge because they acquire an electric charge of the same sign, due to the electric induction.

5090

Volta's Electrophore 5431

The item is composed of a polystyrene base that you can electrify by rubbing it; on this base there is an aluminum disk with insulated handle.

5431

Wimshurst Machine (premium version) 5085

The item has two special disks which don't deform over the course of time.
Two Leyda decomposable bottles.
Adjustable distributor. Spark: 50-60 mm.
Disk diameter: 400 mm.

Plexiglas

5085

Wimshurst Machine (economic version) 5115

It is a light and handy economic version.
Disc diameter 24 cm.
Sparks up to a length of 50 mm can be obtained.
The most significant electrostatics experiments can also be carried out with this generator.

5115

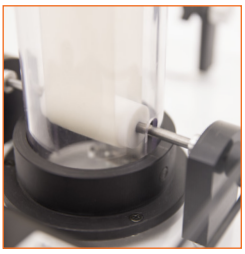
Van de Graaff generator 5549

The Van de Graaff generator is an electrostatic machine which uses a moving belt to accumulate electrostatic charge on a hollow metal globe on the top of a transparent and insulated column, that allows students to see how the system operates.
It is provided with a 225 mm sphere which can generate approximately 150 ÷ 200 KV.
It is provided with an electric variable speed motor or hand driving. Discharge sphere, electrostatic plume and electrostatic whirl are included.
It is possible to adjust the distance between the globe and the discharge sphere thanks to an articulated joint placed on the base.

Dimensions:
Spheres' diameter: 225 mm and 70 mm
Height: circa 650 mm
Base: 250 x 350 mm

Equipment supplied

1 Electrostatic plume
1 Electrostatic whirl



5549

Kit for electrostatic machines (advanced) 5404

Equipment supplied

1 Universal stand
1 Spark panel
1 Metal sphere with insulating handle
1 Electric pendulum
1 Electrostatic whirl
1 Blowing tip
1 Dance of the balls
1 Electrostatic plume
1 Faraday's cage
1 LED with support
1 Faraday's well
2 Crocodile clips
1 Electrostatic engine
2 Leads
1 Articulated discharger

5404

Kit for electrostatic machines (basic) 5051

Equipment supplied

1 Circular base
1 Isolated support with hook
1 Candle with holder
1 Universal support
1 Support with tip
1 Point-shaped conductor
1 Electric whirl
1 Dance of the balls
1 Copple of balls
1 Electrostatic plume
2 Crocodile clip
2 Leads

5051

Electric whirl 5099

It can show the dispersive power of the points thanks to the mechanical effect.

5099

Electrostatic blower 5046

It can show the dispersive power of the points.

5046

Point-shaped conductor 5204

Made of nickel-plated brass, it enables you to experiment on charge distribution in insulated conductors.
Length: 220 mm.
Height: 300 mm.

5204

Articulated discharger 5092

With insulated handle.

5092

Electrostatic bell ring 5073

If you connect the apparatus to an electrostatic machine, the pendulum hits the two bells alternatively because of the electric actions.
Height: 380 mm.

5073

Spherical conductor 5091

For experiments on electrisation (through contact and through induction), on the potential and charge density in conductors. Sphere diameter: 100 mm. Height: 370 mm.

5091

Coulomb's sphere 5087

For experiments on electrostatic induction (Faraday's well, for example). It is supplied with an electric spoon. Sphere diameter: 100 mm.
Height: 370 mm.

5087

Couple of cylindrical conductors 5071

Being a kind of divisible conductor, this apparatus, equipped with two pairs of balls, verifies the electric poles through the phenomenon of the electrostatic induction.

5071

Couple of conductors with electroscope 5089

They have the same function as the previous couple of conductors code 5071, with the advantage of being connected to a two leaf electroscope.

5089

Faraday's cage 5140

The item is supplied with double electric pendulum, thus allowing the performance of experiments on the electrostatic screen. Diameter: 120 mm. Height : 265 cm.

5140

Leyda's bottle 5088

Cylindrical condenser for experiments on the electric capacity. It is supplied with insulated handle to extract the inner framework when the condenser is charged. An electrostatic generator (not supplied) code 5115 or 5085 or 5549 is required to charge the capacitor.

5088

Device for showing the flux lines of the electric field 5351

The item is composed of a tray made of transparent material, to be placed on an overhead projector, and of electrodes to be fixed along the rim of the tray. The latter is filled with castor oil; semolina grains float on the oil's surface. If you connect two electrodes to the poles of the high-voltage generator (code 5324) or to an electrostatic machine, the behaviour of the flux lines of the electric field becomes visible. The item is supplied with 250 ml of castor oil and a bottle of semolina grains.

5351

Plate capacitor 5093

It is a capacitor which allows you to prove that the electric capacity depends on the distance from the framework and on the dielectric material. It can be used to show the flux lines of a uniform electric field too. Products, not provided, but required for doing experiments: wimshurst machine code 5085 and electroscope code 5280.

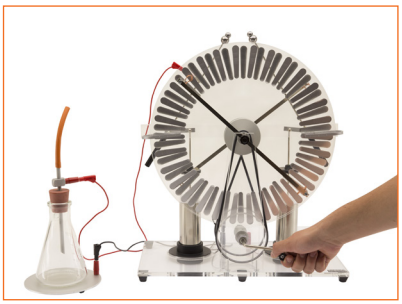
5093

Electrostatic smoke precipitator 5703

The smokes and powders coming out of the chimneys of those mills where toxic substances are used, contribute greatly to air pollution. With this apparatus you can show how to obtain their elimination. Using a rubber tube, a lit sigarette is put in communication with the inside of the flask. If you suck out the air using the pump, the flask fills up with smoke. The internal electrode, which is pointed, and the external plate must be connected to an electrostatic machine (we suggest the code 5085). Switching on the machine, you will notice that , at first, the smoke spins around and then it disappears. If you repeat this operation several times, the walls become black. Cleaning the flask with a bit of white spirit, the tar contained in the cigarette's smoke melts down, allowing the teacher to show the damage caused to the airways.

Equipment supplied

1 Erlenmeyer flask for filtration 500 ml
1 Pointed electrode with rubber cap
1 Manual suction pump with hose
1 Aluminium base
1 Mohr Clamp
1 Bottle of white spirit 250 ml
2 Cables
2 Crocodile clips



Smoke precipitation

5703

Electrostatic cell 5714

An hermetically sealed acrylic case, containing polystyrene tiny balls. When the upper part is rubbed for a long time with a cloth, the electrostaic charge generated makes the balls move, demonstrating the action among charges.

5714

Electrometer with accessories 5045

The item is able to measure electrostatic potentials up to 5kV. The metal stand has a hole for the grounding. It is supplied with disk condenser, Faraday's well and electric spoon.

5045

Franklin Motor 6440

By connecting the terminals to an electrostatic machine, the sphere of insulating material is put in rapid rotation.

6440

Electrostatics S87

18 feasible experiments

Topics

- Electrification
- Protons ed electrons
- Electric forces
- Electrostatic induction
- The pith-ball electroscope
- Conductors and insulators
- The gold leaf electroscope
- How to determine the sign of an electric charge
- The sign of an electric charge
- The wimshurst machine
- Flashes and lightnings
- The electric field
- How to reveal the existence of electric fields
- The power of points
- The electric whirl
- The dancing beads
- The electrostatic plume
- Franklin's electrostatic engine

S87

Elementary circuits kit 5422

This kit enables beginners of the study of the electrical physics, to do experiments on the simplest electric circuits.

Topics

- Lamp with switch;
- Lamps in series;
- Lamps in parallel

Equipment supplied

1 Battery holder - 4 positions
2 Knife switches
2 Lamps with lamp holder - 6V
6 Leads

5422

Electrical leads, safety plugs

Available in black or red
Type: banana - banana
Diameter: 4 mm.
Max current: 8 A
Max voltage: 1000 V
Metal part with protective retractable sheath in order to avoid accidental contacts.

Single, length 25 cm	5160
Single, length 50 cm	5161
Single, length 100 cm	5162

5160 - 5161 - 5162

Set of 10 cables 5191

Type: crocodile - crocodile
Length 50 cm. Max current: 5A.

5191

Rack for cables 5325

24 spaces, it can be fixed to the wall.

Knife switch 5147

Max voltage: 12 V. Max current: 5 A.

5147

Lampholder 5164

Lampholder with two 6 V lamps.

5164

Bulb E10 12V-3A 5271

Suitable for bulb-holder code 5164.

5271

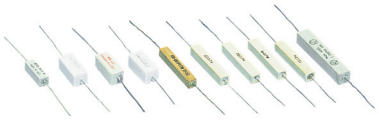
Bulb E12 6V/2W 5010

To be used with bulb-holder code 5009.

5010

Series of 10 resistors 5176

Values Ω: 10 - 12 - 15 - 18 - 22 - 56 - 68 - 100 - 120 - 150.
Power: 5 W. To be used with bases code 5056 (sold separately) in order to produce batteries in series and in parallel.

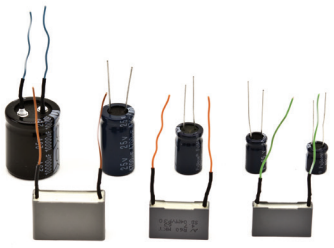


5176

Set of 10 capacitors 8502

To be used with bases code 5056, sold separately, in order to constitute batteries in series and in parallel. Maximum voltage: 25V.
Equipment supplied:

2,2 µf - 1 pz
4,7 µf - 1 pz
10 µf - 1 pz
470 µf - 1 pz
1.000 µf - 2 pz
2.200 µf - 2 pz
4.700 µf - 1 pz
10.000 µf - 1 pz



8502

Nickel-chrome wire 5076

Length 100 cm.
It has terminal piston pins to make tests on Ohm's laws.

5076

Black crocodile clip 5062N
Red crocodile clip 5062R

5062N - 5062R

Crocodile clip 5192

With insulation, with button.

5192

Lamp holder E12 on base 5009

To be used with code 5010.
Dimensions: 103x54x30 mm.

5009

Resistor-holder and Capacitor-holder base 5056

Dimensions: 103x54x30 mm.

5056

Switch on base 5008

Dimensions: 103x54x30 mm.

5008

Silica diode on base 5146

Dimensions: 103x54x30mm.
It can straighten up a half-wave.

5146

Deflector on base 5136

Dimensions: 103x54x30 mm.

5136

Thermistor NTC on base 5144

Dimensions: 103x54x30 mm.
Its resistance varies with a negative temperature.

5144

Rheostat 22 Ω on base 5132

Dimensions: 103x54x30 mm.

5132

Thermistor PTC on base 5389

Dimensions: 103x54x30 mm.
It's resistance with a positive temperature.

5389

Inverter on base 5137

Dimensions: 103x54x30 mm.

5137

Photoresistor on base 5133

Dimensions: 103x54x30 mm.
It varies its resistance as a function of the light received.

5133

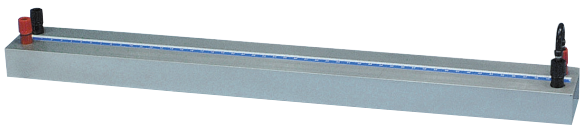
Series of conductors 5098

For the verification of Ohm's laws. Dimensions: 1000 x 100 mm.
Composed of:
1 Kanthal wire, Ø 0,30 mm; 2 Nichel-chromium wire, Ø 0,3 mm; 1 Constantan string wire, Ø 0,4 mm; 1 Bridge; 1 Base.

5098

Ohm's law table 8504

To be used with the set of wires code 8503 (see above) in order to test Ohm's laws. Dimensions: 500x60 mm.
It is supplied with a short-circuit bridge.



8504

Set of 4 metal wires 10 m 8503

Composed of:

Nichel	1,376 Ω/m	Ø 0,3 mm	Nichel-Cromo	15,63 Ω/m	Ø 0,3 mm
Constantan	3,918 Ω/m	Ø 0,4 mm	Kanthal	19,45 Ω/m	Ø 0,3 mm

8503

Kit for experiments on the electric circuits 5130

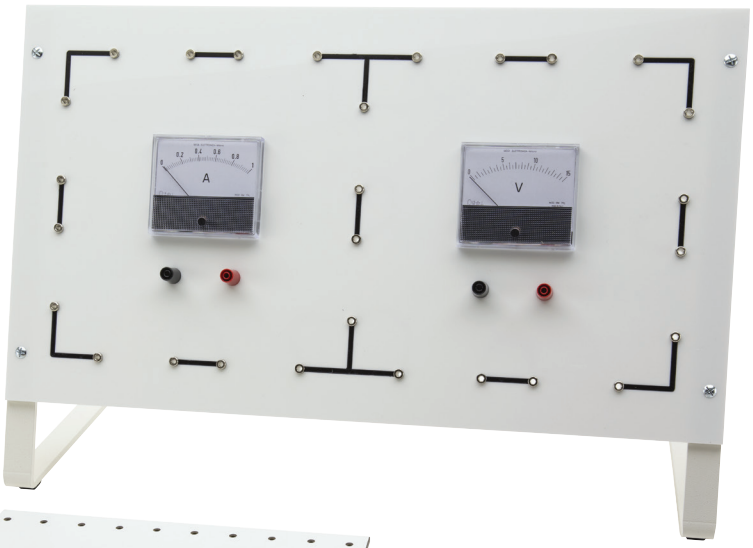
To be used with an electric, low-voltage power unit ,which can be adjusted from 0 to 12V DC.
Structure made of painted metal.Panel dimensions: 57x33 cm.

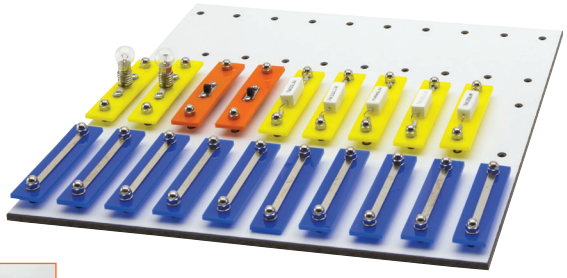
Topics

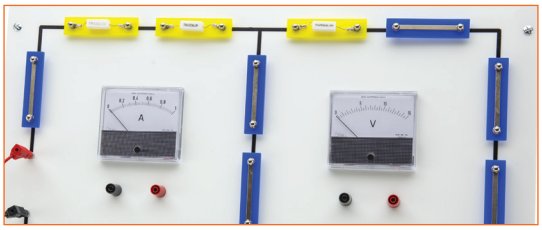
- The electric circuit
- Use of the instruments
- Verification of Ohm's first law
- Dependence of resistance on temperature
- Lamps in series
- Lamps in parallel
- Resistances in series
- Resistances in parallel
- Electrical net

Equipment supplied

4 Electrical leads 30 cm	2 Bridges with switch
2 Electrical leads 100 cm	1 Resistor bridge = 12 Ω
2 Iron holders for panel	1 Resistor bridge = 18 Ω
1 Panel with instruments	1 Resistor bridge = 56 Ω
1 Plate for circuits	1 Resistor bridge = 100 Ω
10 Bridges with short-circuit	1 Resistor bridge = 120 Ω
2 Bridges with lamp	



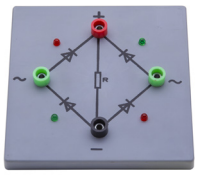




5130

Graetz's bridge 5233

The item is mounted on base 100x100 mm. It can strighten up two half-waves, visualizing the conduction state of the diode through the use of LED.



5233

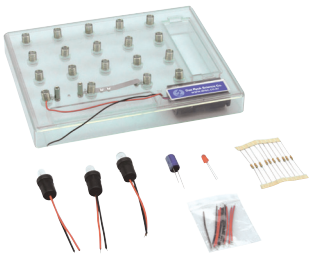
Resistances box 5270

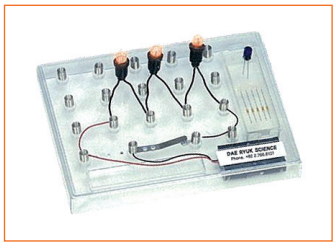
With six decade boxes.
Percentual mistake 0,1%.
Plastic case.
Measurement range: from 0 to 1.111.110 Ω with 1 Ω step.

5270

Board for simple electric circuits 5712

This apparatus enables you to create connections in series and parallel between different electrical dipole, such as light bulbs, resistors, condensers, leds, etc. simply through the use of spring connectors. It includes a small space to store all different components and a battery-holder to insert two AA type batteries.





5712

Linear didactic rheostats

For voltages up to 24 V.

Resistance 10 Ω Max current 2 A	5218
Resistance 50 Ω Max current 1,5 A	5219
Resistance 200 Ω Max current 1,25 A	5220

5218 - 5219 - 5220

Support for mounting boards 5333

For a better view of the circuits assembled on the table.
It should be used with codes 5332 and 5334.

5333

Modular kit to study electric circuits 5332

This modular kit enables the performance of many experiments on electrical conduction, reducing to a minimum, the use of connecting cables. In this way, besides simplifying the operating production of circuits, their layouts are highlighted. We suggest our power supply code 4991, not supplied with this apparatus.
Assembly table dimensions: 45x33 cm

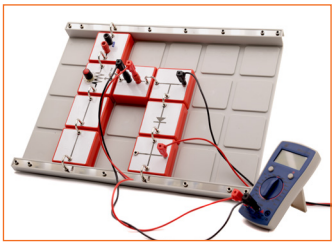
14 feasible experiments

Topics

- Bulb with switch
- Protection fuse
- Bulb Series with single point
- Parallel Bulbs with single point
- Parallel Bulbs with 2-way switch
- Bulbs with dual control with 2-way switch
- Bulbs with dual control with relay
- Use of the voltmeter and the ammeter
- First ohm's law
- Second ohm's law
- The rheostat
- The potentiometer
- Series circuits
- Parallel circuits

Equipment supplied

2 Modules with bulb holder	1 Module with 20 Ω rheostat
2 Bulb 6V 2W	1 Module with relay
6 Electrical leads 60 cm	1 10 metres of kanthal wire
1 Assembly table	1 Couple of resistors 22 Ω - 56 Ω
4 Linear conductors	1 Nickel-chromium wire
2 L-shaped conductors	2 Crocodile clips
1 T-shaped conductor	10 U bolts
1 Set of 4 insulators	1 Voltmeter DC
2 Modules with switches	1 Ammeter DC
1 Module with fuse holder	10 Fuses
4 Universal connectors	1 Box



5332

Modular kit for the study of basic electronics 5334

This modular kit allows the performance of several experiments on electronical principles: from reactive components to semiconductors. The main advantage lies in the minimum use of the connecting cables. In this way, besides simplifying the operative production of circuits, their schemes are highlighted. The function generator (code 5718) required to perform the experiments with alternating current must be purchased separately.
Assembly table dimensions: 45x33 cm.

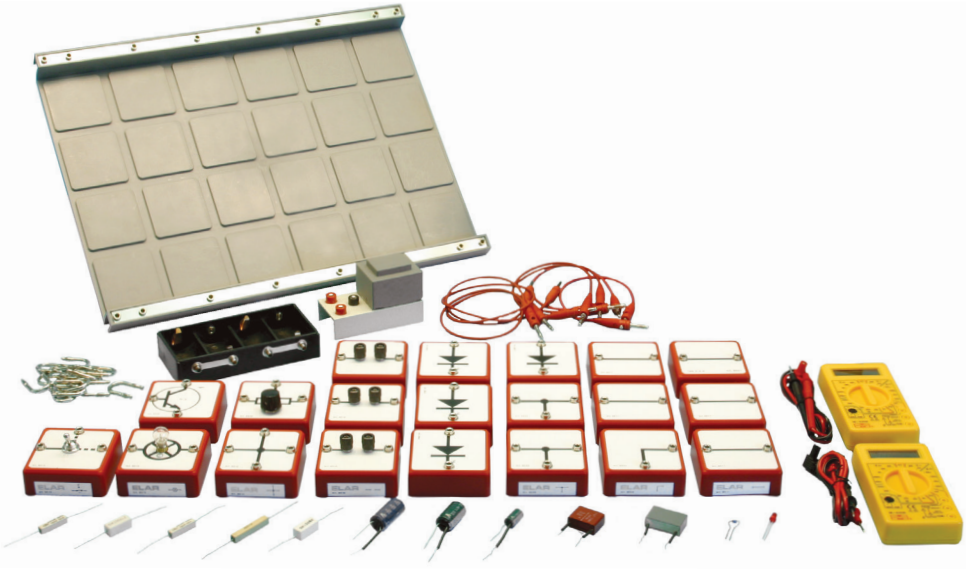
18 feasible experiments

Topics

- The condenser with direct current
- Effective voltage and current
- The condenser with alternating current
- The capacitive reactance
- The inductive reactance
- The RCL circuit
- Low-pass filter
- High-pass filter
- Conductivity in metals and semiconductors
- P-N junction: the diode
- The half-wave rectifier
- The double half-wave rectifier
- The filtered rectifier
- The transistor
- The transistor as interrupter
- The transistor as amplifier
- The photoresistor
- The thermistor

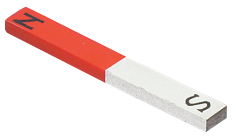
Equipment supplied

1 Module with bulb holder
1 Bulb 6V 2W
6 Electrical leads 60 cm
1 Mounting boards
5 Linear conductors
1 L-shaped conductor
2 T-shaped conductors
1 Module with deflector
6 Universal connectors
1 Set of 5 different condensers
1 Set of 5 different resistances
1 Module with potentiometer 2 KΩ 2 A
4 Modules with silicon diodes
1 Module with transistor
2 Universal digital Multimeter
1 Cross conductor
16 U bolts
1 Battery holder
1 Module with inductor
1 Photoresistor
1 NTC 47 Ω - 50 Ω
1 Box



5334

Rectangular magnet 5279
Dimensions: 170x20x10 mm..



5279

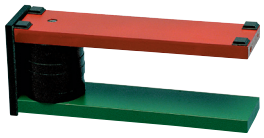
U-shaped magnet
Dimensions: 55x10x14 mm. **5281**
Dimensions: 75x16x40 mm. **5286**

5281 - 5286

Magnet 5206
U-shaped.

5206

U-shaped magnet 5173
Dimensions: 200x75x45 mm.



5173

Al- Ni-Co alloy magnets
Made of cobalt and nickel alloy, these magnets are able to create magnetic fields much more intense than those created by steel magnets.
Moreover, their magnetisation lasts for decades.

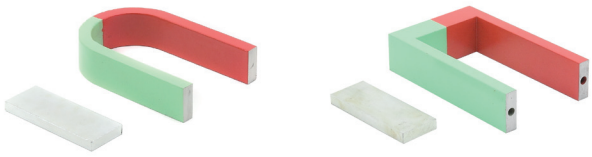
Linear magnets with round section
Dimensions: 60 x 6 mm circular, single. **5238**
Dimensions: 100 x 10 mm circular, single. **5024**
Dimensions: 150 x 12 mm circular, single. **5169**
Dimensions: 150 x 12 mm circular, couple. **5170**

5238 - 5024 - 5169 - 5170

U-shaped magnets with stand
Dimensions: 30 x 20 x 21 mm. Rod Ø 6 x 135 mm **5077**
Dimensions: 45 x 29 x 30 mm. Rod Ø 6 x 135 mm **5141**

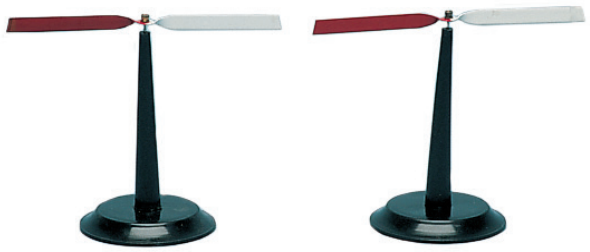
5077 - 5141

U-shaped magnets without stand
Dimensions: 80 x 52,7 x 21 mm. Poles distance: 40 mm. **5382**
Dimensions: 130 x 80,5 x 30 mm. Poles distance: 60 mm. **5383**



5382 - 5383

Couple of magnetic needles 5225
The item can show the interaction between magnetic poles
Needle length: 140 mm. Height: 120 mm.



5225

Disk magnet 5182
SINTEROX/F alloy
Diameter: 18 mm.
Thickness: 5 mm.

5182

Ring magnet 5183
SINTEROX/D alloy
Outer diameter: 51 mm.
Inner diameter: 24 mm.
Thickness: 9 mm.

5183

Neodymium magnets
Made of Neodymium-Iron-Boron alloy, they produce a magnetic field of exceptional intensity (about 1 Tesla).

Disc magnet 8516
Diameter 25 mm, Thickness 10 mm.

8516

Ring magnet 8517
Outer diameter: 25 mm.
Inner diameter: 10 mm; thickness 8 mm.

8517

Magnetic needle 5174
Magnetic needle with protractor.
Mounted on rod 100 mm and base.
Needle length: 60 mm.

5174

Rotating stand for magnets 5250
It consists of a stand ,rotating on a point, so to highlight the actions between magnetic poles.

5250

Set of 10 magnetic needles 5296

Needle length 30 mm; the neddles allow you to draw the flux lines of a magnetic field.

5296

Set of 10 magnetic in-box needles 5358

Diameter 20 mm, height 8 mm.

5358

Set of 12 compasses 5359

Diameter 25 mm, height 6 mm.

5359

Apparatus to show the magnetic spectrum 5027

Equipment supplied

1 "U"shaped magnet
1 Circular base
1 Plexiglas plate
1 Iron filings bottle

5027

Magnetic forces apparatus 5125

This item lets you visualise the remote action of magnetic forces.
With two ring magnets.

5125

Magnetoscopes 5293

Part 1

It is composed of a transparent cube (80 x 80 x 80 mm) containing a silicon oil solution with iron filings in suspension into it. Inserting the supplied linear magnet in the central hole, the wire-like iron particles line up to the space flux-lines of the field generated by the linear magnet.

Part 2

It is based on the same principle of the previous apparatus; it enables a bidimensional representation of the flux lines both of a linear and "U"-shaped magnet, both supplied as apparatus'equipment. Dimensions 120 x 60 mm.

5293

Magnetism kit 5414

The item can show, in an elementary way, the properties of magnets. It can also discover which substances are not subject to magnetic force.

5414

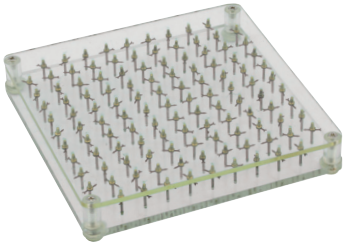
Magnetoscope 5405

98 iron bars protected by a housing are free to be arranged randomly.
Under the action of an external magnetic field, for example by inserting the magnet model into the extensible solenoid, code 5178, the bars align like the magnetic moments of the molecules of ferromagnetic bodies. It can be used to display the force lines of the magnetic field.
With magnets code 5024 or code 5286. Dimensions 75x150 mm.

5405

Magnetoscope with needles 5420

As in 5405, 117 small iron bars, protected by a case, are free to move randomly.
Dimensions: 150x150 mm.



5420

"Play and learn" kit 5541

You can learn the properties of magnetic bodies enjoying yourself.

Equipment supplied

1 Magnetic spade	50 Magnetic clips
1 Horseshoe magnet	24 Coloured magnetic tokens
10 Magnetic balls	1 Magnets stand

5541

Set of accessories for experiments on magnetism 5322

Topics

- The magnet
- Two magnetic poles
- The compass
- Magnetic forces
- Magnetic induction
- The magnetic spectrum

Equipment supplied

2 Magnetic needles
2 Linear alloy-made magnets
1 "U"-shaped steel magnet with stand
1 Plexiglas plate
1 Rotating stand
1 Iron filings bottle
1 Compass
1 Case

5322

Precision compass 5231

Diameter: 100 mm.
With wind rose.

5231

Simple compass 18/E

Diameter: 45 mm.

18/E

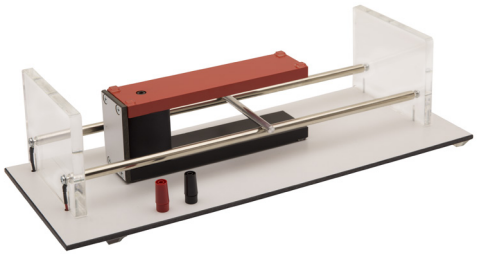
Walk compass 5171

Liquid pocket compass Ø 45mm with cover, ring and indicator. Plastic body.

5171

Apparatus for the verification of Lorentz force 5177

It consists of two metal tracks where a cylindrical aluminium bar can roll while positioned in order to be immersed in the field of a permanent magnet. Allowing the current to flow in the aluminium bar through the use of generator code 5248, the bar is given a force whose direction is determined through the "the left hand" rule.
Track length: 45x17 cm.



5177

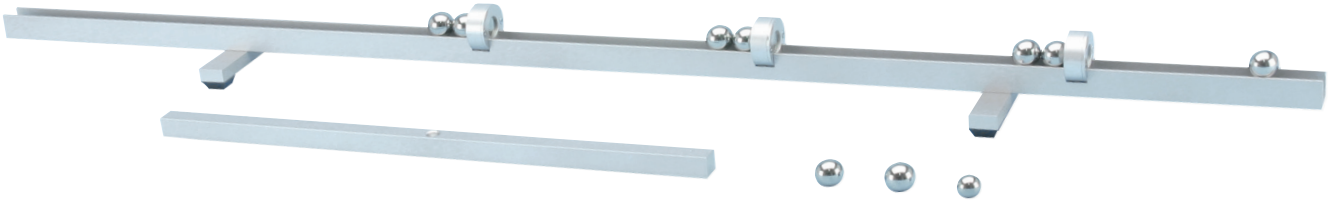
1 Stage magnetic gun (Gauss gun) 5369

The magnetic field of a permanent magnet decreases quickly as distance increases. The sphere in the charger, is located in the field of a powerful neodymium magnet; therefore it is abstracted by a force which increases quickly as the sphere's distance from the magnet decreases.
Once delivered, its potential energy turns into kinetic energy.
Two 1 stage guns may be connected in series to create a 2 stage gun.
Gun length: 40 cm.

5369

3 Stage magnetic gun 5370

The magnetic gun is a mechanical model that allows you to explore in a simple and intuitive way, without any calculation, concepts such as energy configuration, exothermic systems and reversible reactions.
It is also a very useful exercise to understand mechanical systems using energy balances and symmetries rather than analytical or mathematical details.
Supplied with 3 magnets, 2pcs Ø 16 mm spheres and 8pcs Ø 20 mm spheres.
Track length: 100 cm.



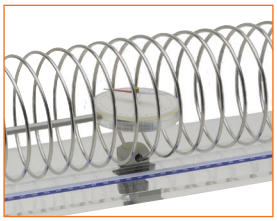
5370

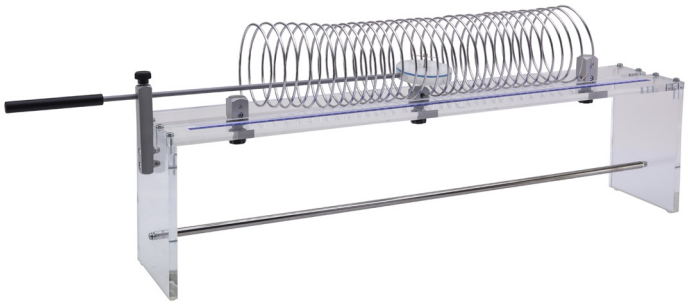
Extensible solenoid 5178

This item allows the study of the magnetic field generated by a solenoid, because it is possible to vary the coil number per length measurement unit. Once the magnetic needle has been positioned toward the earth field and the solenoid has been positioned in a perpendicular direction, the tangent of the needle's deviation angle is proportional to the intensity of the magnetic field and, therefore, to the intensity of the electric current and to the number of coils per length measurement unit.
To be used with generator code 5360. Dimensions: 63x15x20 cm.
It is possible to study the dependence of the magnetic field by the number of turns per meter using a magnetic field sensor.

Equipment for online use - not supplied

1 Sensor holder	code 5399
1 Magnetic field sensor	code 9091
1 Current sensor	code 9027
1 Interface	code 9001
or	
1 USB magnetic field sensor	code 9067
1 USB current sensor	code 9073





Suitable to be used with sensors

5178

Electromagnetic scale 5179

The electromagnetic scale has a solid and elegant plexiglass structure. One of the two arms ends with a rectangular aluminium coil immersed in the field of a powerful permanent magnet. The other arm has two sliding masses, which allow the item to obtain equilibrium at rest. Allowing the current to flow through the use of apparatus code 5361, a force F appears between the magnetic field B and the electric current i, whose value is given by the Ampere law:

$F = B \cdot l \cdot i \cdot \text{sen } \alpha$

where l is the length of the conductor and α is the angle created between the conductor and the magnetic field. It is possible therefore to verify that the intensity of the force reaches its maximum when α=90° and it is zero when α=0°. Using the power supply, the value i of the electric current can be read with an ammeter and, therefore, it is possible to deduce the permanent magnet's induction value B. The experiment can be repeated replacing the permanent magnet with the solenoid. In this way it is possible to verify the ratio which gives the value of the magnetic field inside a solenoid. Scale sensibility: 10 mg. Dimensions: 58x18x17cm.

Equipment supplied

1 Electromagnetic scale
1 Permanent magnet
1 Solenoid
1 Weight box 200 g with gram fractions

5179

Electromagnetic actions kit 5184

With this apparatus it is possible to experiment on currents-magnets and currents-currents interactions. Recommended power supply code 5360 not provided.

Equipment supplied

1 Frame
2 Electrical leads 60cm
1 Rectangular reel
1 "U"conductor
2 Crocodile clips
1 Linear magnet
1 Magnetic needle
1 "U"shaped magnet
1 Set magnetic needle

5184

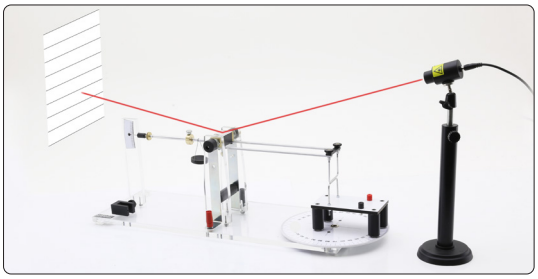
Accessories for electromagnetic scales

Set of accessories for 5179 5458

Thanks to this set it is possible to deepen the Ampère principle and the Ørsted experiment.

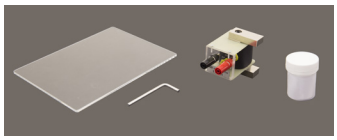
Laser for optical lever 5459

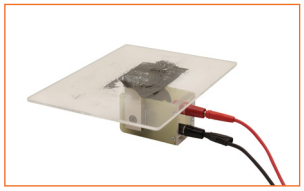
Thanks to the optical lever, every small angle variation is amplified for easier measurement.



Apparatus to show the field of an electromagnet 5356

It consists of a plastic material plate and an electromagnet (composed of an inductor and a metal nucleus) which must be placed under the plate. The item is supplied with a bottle of iron filings and an allen screw to assemble the electromagnet.
Maximum voltage: 6V.





5356

Coil 400 turns, 0,69 A 5375

Internal hole for core: 28x28 mm.

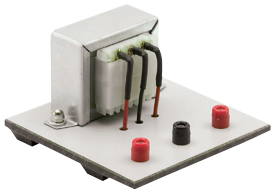
5375

Coil 1600 turns, 1A 5078

Internal hole for core: 20x20 mm.

5078

Inductor 8510

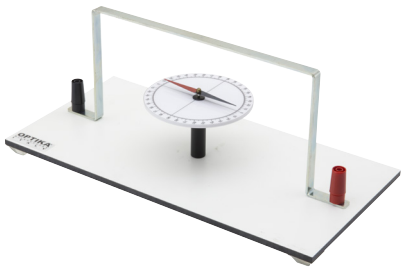


Features in alternating current 1 kHz:
L=0,22 H, R= 56 Ω between two extreme poles;
L= 58 mH, R= 24 Ω between an extremity and the intermediate pole
Features in direct current:
R= 0,6 Ω between two extreme poles, R= 0,3 Ω between an extremity and the intermediate pole.

8510

Linear Ørsted apparatus 5857

The item can show the magnetic effect of electric current flowing in a linear conductor.
Provided with magnetic needle and goniometer that allows you to take measures during the experimentation. To be used with a power supply: 5 A.



5857

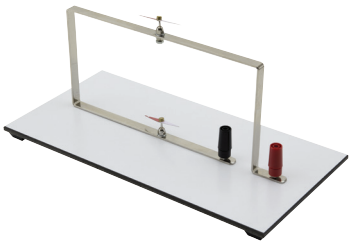
Circular Ørsted apparatus 5858

The item can show the magnetic effect of the electric current flowing in a circular conductor.
Provided with magnetic needle and goniometer.
To be used with a power supply: 5 A.

5858

Ørsted apparatus with two needles 5122

The item can show the magnetic effect of the electric current flowing in a circular conductor through the use of 2 magnetic needles. To be used with a power supply: 5 A. (Recommended Code 5360).



5122

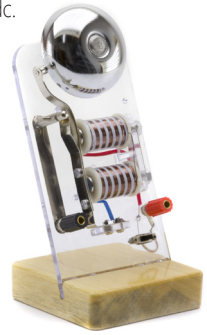
Horseshoe-shaped electromagnet 5274

With anchor and stand.
Voltage: 3 Vdc. Height: 35 cm.

5274

Electric alarm model 5186

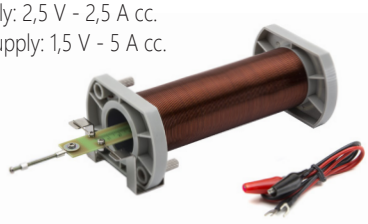
It can show the functioning principle of an electric alarm. Dimensions: 9x9x19 cm.
Voltage: 6 V dc.



5186

Apparatus for the electrodynamic actions 5288

This apparatus consists of a solenoid containing a linear conductor positioned perpendicularly to the flux lines. Being possible to balance the electrodynamic interaction force, it is possible to perform quantitative experiments too.
Dimensions: 200x90x90mm. Internal diameter: 38mm.
Scale power supply: 2,5 V - 2,5 A cc.
Winding power supply: 1,5 V - 5 A cc.



5288

Faraday's experiments kit 5128

With this kit it is possible to perform the fundamental experiments on electromagnetic induction.

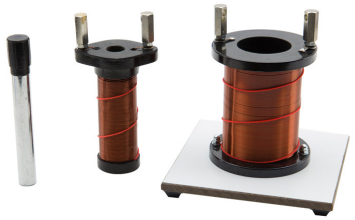
Equipment supplied

1 Battery	2 Electrical leads 60 cm
1 Switch	3 Electrical leads30 cm
1 Galvanometer	2 Crocodile clips
1 Linear magnet	1 Box
1 Double coil	

5128

Double coil for induced currents 5273

This item enables you to perform the most important experiments of Faraday on electromagnetic induction. The closure or the opening of the primary solenoid , its movement or that of its iron nucleus, produce induced currents in the secondary solenoid; these currents can be highlighted with the galvanometer code 5047.
Primary number of coils: 400. Secondary number of coils: 1150.
Work voltage: 6 - 10 V. Dimensions: 65 x 65 mm.



5273

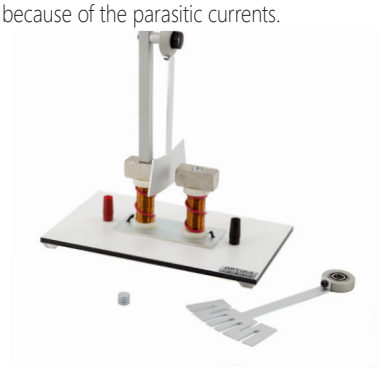
Apparatus for the verification of Lenz's law 5285

This simple apparatus allows the verification of Lenz law in a simple way. If you insert a linear magnet into the non-interrupted ring, the ring is rejected , while it is attracted during the extraction of the magnet; this fact proves that the induced currents' direction is always opposite to the one of what has generated them. The same thing doesn't happen with the interrupted ring.

5285

Waltenhofen pendulum 5120

If you allow two aluminium sectors, one whole and the other cut, to oscillate with the excited magnet, you can see that the oscillation slows down more quickly in the first instance, because of the parasitic currents.



5120

Ruhmkorff's coil 5208

For 50 mm long sparks; power supply :6-12 V dc.
A power supply is required (code 4991, not provided).

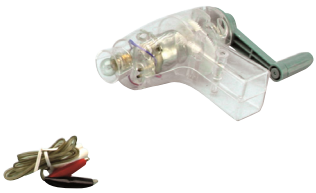
Weight
2.450 Kg
Length
295 mm
Width
180 mm
Height
208 mm

Input voltage
9-12 V, DC
Max current
5 Amp
Maximum sparkle
50 mm

5208

Manually operated dynamo 5393.1

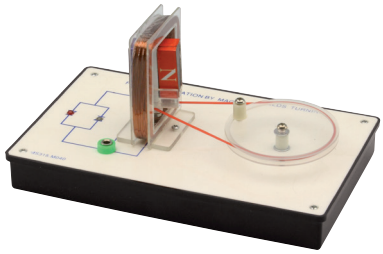
It is contained into a transparent case, in order to let you see how electromagnetic induction can be exploited to produce electric energy. Moreover it is possible to verify the dynamo's principle of reversibility. With double-ended crocodile clips cable.



5393.1

Alternator-engine model 5419

By turning the handle, the magnet rotates inside the coil, inducing an electric current which turns on the LEDs. Dimensions: 205 x 125 x 25 mm.



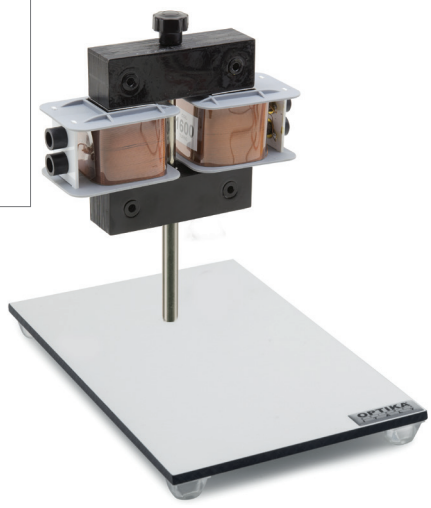
5419

Modular transformer 5114

It consists of a nucleus made of laminated ferromagnetic material which can be divided into two parts (one is "U" shaped, the other straight) in order to replace the coils. Max. applied voltage: 6 V ac.

Equipment supplied

1 base
1 "U"shaped nucleus made of laminated iron
1 Closure yoke
1 Asta di sostegno
1 Coil 1600 turns
1 Candle
1 Aluminum ring with cut
1 Coil 400 turns
1 Coil 50 turns
1 Aluminium ring
1 Melting pot with handle



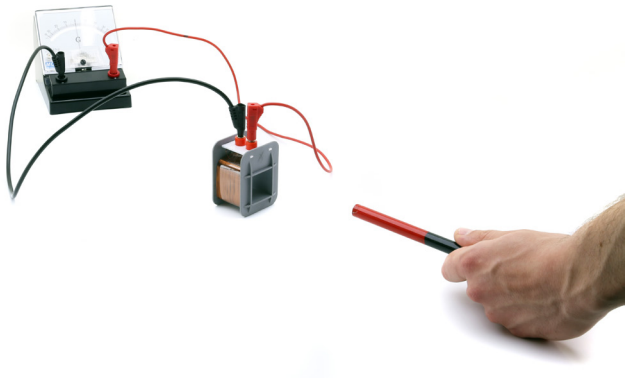
5114

Introduction

The plane of movement, also mentioned in the section of the catalog dedicated to mechanics, is made up of the superimposition of a layer of plastic and one of aluminium, so as to allow for an in-depth study of the basic motions of dynamics: the uniform rectilinear motion and the uniformly accelerated motion in a straight line.
Particularly interesting is the fact that the uniform rectilinear motion is achieved by arranging the plane with the metal surface upwards, and using the phenomenon of electromagnetic induction generated by the movement of the magnet placed under the carriage.
When the carriage begins to move along the metal plane, the movement of the magnet applied to its base causes a variation of the magnetic flux which, according to Lenz's law, produces a force which makes the motion of the carriage uniform.
Instead, by placing the trolley on the plastic surface, it is possible to obtain accelerated motions.
Thanks to the special support, the plane of movement is transformed into an inclined plane, which also makes possible considerations on friction and conservation of mechanical energy. The supplied material allows the use of a distance sensor for the study of the movements in real time, in order to be able to graphically and analytically deepen the laws that govern these movements.

Faraday's law - Neumann - Lenz 8217

Electromagnetic induction is the operating principle of many everyday appliances such as, for example, voltage transformers. This collection proposes the execution of the experiments carried out by the Englishman M. Faraday around 1820.
After the Danish H. C: Oersted demonstrated that it was possible to create a magnetic field using an electric current, contemporary physicists realized that there must be a correlation between electricity and magnetism. To discover the nature of this connection, they performed a series of experiments which can be accomplished with the simple means provided in this collection. In experimental subjects, such as physics, it is not enough to read the description of experiences performed by others. It is educationally essential to carry out these experiences in person.



8217

Topics

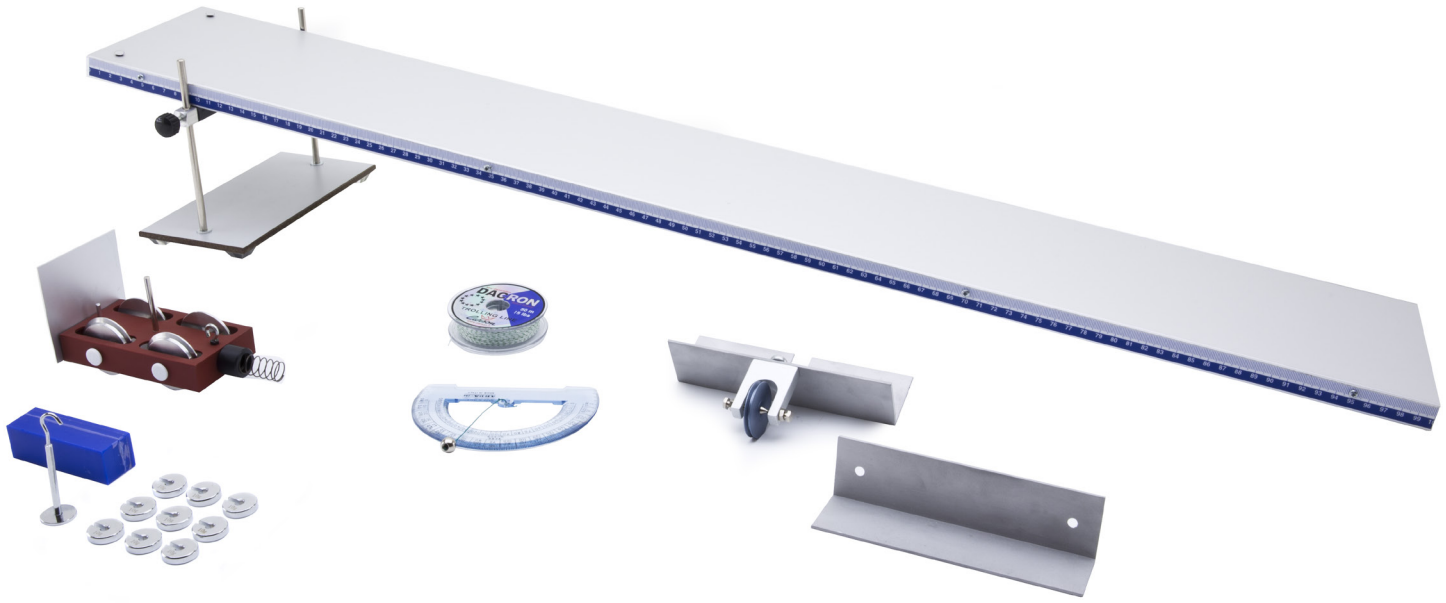
Faraday's law - Neumann	Experience N.3
Faraday's law - Neumann - Lenz	Experience N.4
Experience N.1	Conclusions
Experience N.2	

Material supplied

1 galvanometer
1 coil 1600 turns
1 linear magnet
2 cables 50cm.

Motion plan NEW 8218

The movement plane, made up of the overlapping of a layer of plastic and one of aluminum, allows for an in-depth study of the basic motions of the dynamics:
uniform rectilinear motion and uniformly accelerated rectilinear motion. The uniform motions can be achieved using the plane with the metal surface facing upwards, thanks to the phenomenon of electromagnetic induction generated by the movement of the magnetic carriage on the aluminium. Conversely, by placing the trolley on the plastic surface, it is possible to obtain the accelerated motions. Thanks to the special support, the plane of movement is transformed into an inclined plane which also makes possible considerations on friction and conservation of mechanical energy. For the execution of quantitative experiments it is necessary to have a distance sensor cod. 9041.



8218

Sensor kit (accessory for 8218) 8106

This additional kit to the movement plan allows you to obtain position / time graphs via a simple bluetooth connection, so as to collect the data of the experiences carried out and understand them more deeply.

Topics

- Base
- Double clamp
- Modular metal rod
- USB distance sensor (Korea Digital)

Material supplied

- 1 Base
- 1 Double clamp
- 1 Modular metal rod
- 1 USB distance sensor (Korea Digital)

8106

Apparatus to verify the electromagnetic induction law and the principle of action-reaction 1342

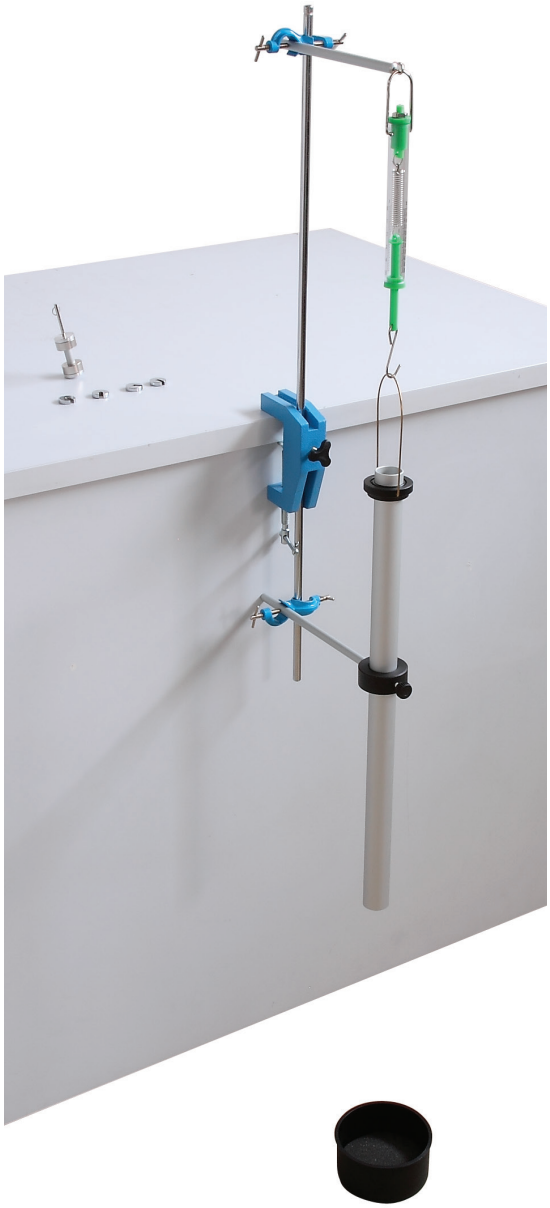
Inside the aluminium tube, a magnet falls with uniform motion.
The explanation is the following: during the fall of the magnet, the aluminium tube is linked to a variable magnetic flux and therefore it has induced currents whose directions, according to Lenz's law, are opposite to what has generated them, i.e. the magnet's motion, in this case.

The consequence is that the latter , in the beginning phase, falls with uniformly accelerated motion because it's moved by a vertical force whose intensity is equal to the difference between its weight P and the electromagnetic force F. This force is proportional and opposed to the speed of the fall, i.e. it is a viscous force: F = - kv. The moment the magnet reaches the speed v0 so that P - kv0 = 0, its motion becomes uniform.

Thanks to the principle of action and reaction, the magnet reacts on the tube with an equal and opposite force and, therefore, during the fall with uniform motion of the magnet, the spring scale measures a force with an intensity equal to the sum of the tube's and the magnet's weights.

Equipment supplied

1 Table clamp
2 Double bossheads
1 Rod 750 x 10 mm
1 Spring scale 1000 g
1 Kit of magnets
4 10 g masses, diameter 4 mm
1 Aluminium tube with ring-shape support
1 Container to collect the magnets
1 Ring-shape PVC support for tube
1 Support for spring scale



1342

Electromagnetic pendulum 8515

Essential item to study electromagnetic interactions. It consists of a linear magnet hanging from a spring and where a spool is located. Starting the magnet's motion, an electromotive force is induced in the spool which is measurable at the resistor's ends. Similarly, making a/c circulate in the spool, the magnet starts its motion.

Topics

- Electromagnetic induction;
- A/c production;
- Electromagnetic resonance.

Equipment supplied

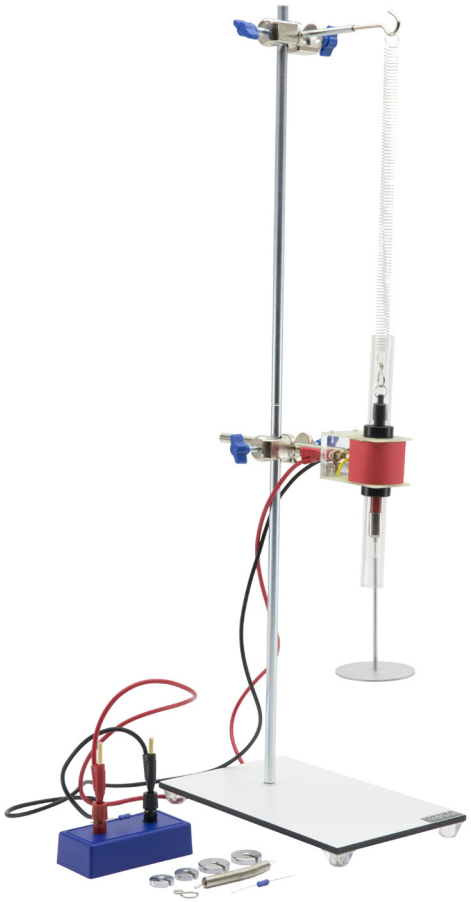
1 1600 turns coil fitted with support and plexiglas tube
1 Linear magnet, diam. 10 mm with support
2 Coil spring
1 Magnetic weights-holder
2 Mass 10 g
2 Mass 20 g
2 Electrical leads 120 cm
1 Rectangular base with rod 10x800 mm
2 Boss-head
1 Bar with hook
1 Base with two bonding posts boss-heads
2 Resistors

Equipment required, not supplied

1 Function generator code 5718

Equipment for online use - not supplied

1 Interface code 9001
2 Voltage sensor code 9029
2 Current sensor code 9027
1 Magnetic field sensor code 9039
or
2 USB Voltage sensor code 9074
2 USB Current sensor code 9073
1 USB Magnetic field sensor code 9067



Suitable to be used with sensors

8515

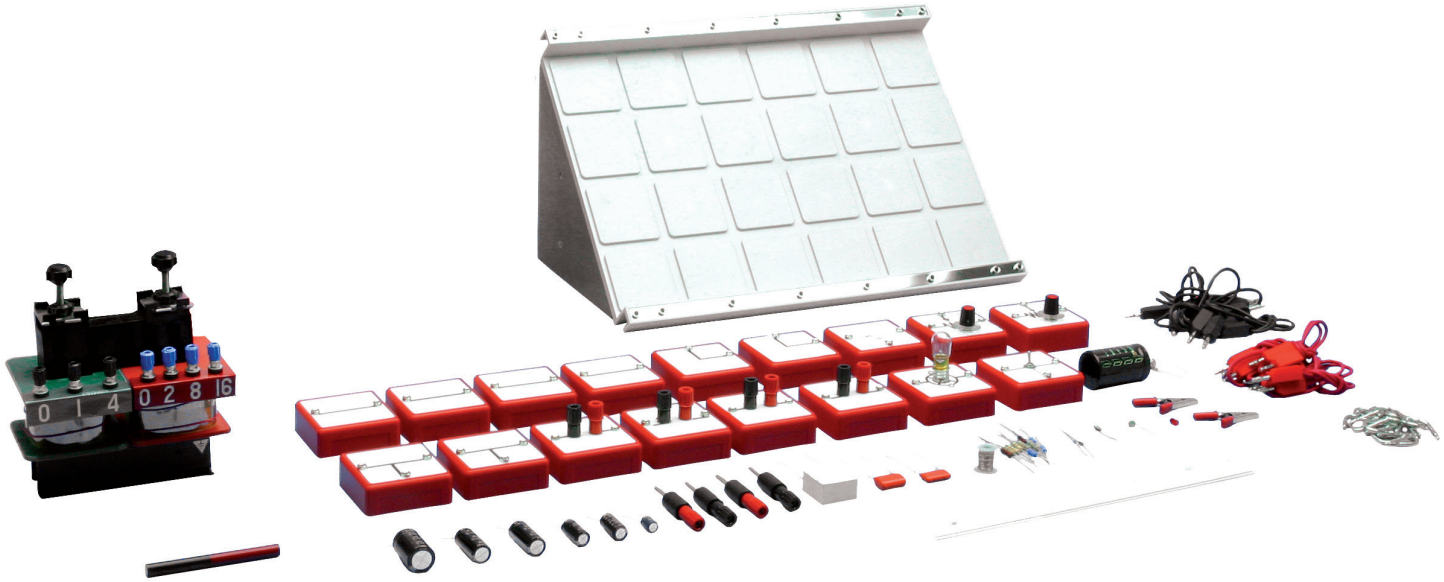
Electromagnetic Fall 5424

A free-falling magnet going through coils produces an induced voltage that lets the LEDs turn on. The production of light energy is obtained at the expense of the kinetic energy of the magnet, which slows down when passing through the coils. If you make a dynamic comparison with an identical magnet, falling down simultaneously along a tube without coils, it can be seen that the latter always comes down first.

5424

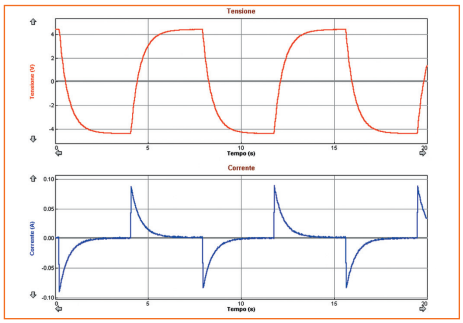
Electromagnetism kit 8514

Laboratory experiments on electrical circuits are difficult due to the use of cables to connect the different parts. It becomes difficult to vary the typology of a circuit without risking incorrect or damaging connections. In addition we risk losing sight of the structure of the circuit. This kit is based on modules which can be quickly assembled on a table. In this way, the type of circuit is immediately recognizable and replacing a part or changing the circuit become simple and quick.



Topics

- Ohm' Laws
- Adjustment in series/parallel
- Charging and discharging of the condenser
- Autoinduction
- The reactive components in a/c
- Magnetic field in a solenoid
- Electromagnetic induction
- Tranformer
- Oscillator circuits
- Resonance
- Rectifier circuit



Charge and discharge of a capacitor

To perform the experiment "the magnetic field in a solenoid" is recommended the product code 5178 "Extensible solenoid".

Equipment supplied

1 Assembling table	2 "T" conductors	1 Kantal wire	1 Modular transformer
14 U bolts	4 Linear conductors	2 Crocodile clips	1 Linear ruler
1 Set of 10 resistors	2 "L" conductors	1 Potentiometer, 22 Ω	1 Set of spring hook for magnet
1 Set of 4 non linear dipoles	1 Switch	1 Bulb holder	1 pdf teaching guide
1 Set of 10 Capacitors	4 Universal connectors	1 Bulb	4 Extensions to crocodile clips
10 Electrical leads	4 Insulators	1 Bar magnet	

Equipment required - not supplied

1 Generator of low frequency signals	code 5718
1 Power unit 0-5A	code 5248

Equipment for online use - not supplied

1 Interface code 9001
1 Magnetic field sensor code 9039
2 Voltage sensor code 9029
2 Current sensor code 9027
or
1 USB magnetic field sensor code 9067
2 USB voltage sensor code 9074
2 USB current sensor code 9073

Suitable to be used with sensors

Plasma sphere 5367

Glass sphere Ø 20 cm, containing a rarefacted gas mixture. The central electrode has an alternating voltage of 10.000 volt; for this reason it creates electric discharges which spread toward the outside. If you move your finger close to the surface, the discharges concentrate in proximity to your finger because of the conductivity of the human body. So the sphere can be used to distiguish conducting objects from insulating objects. It can be used to prove the existence and the nature of electromagnetic waves, too. In fact, a neon tube moving close to the sphere lights up because of the energy carried by the electromagnetic waves. If you interpose a paper sheet, the phenomenon goes on ,because the waves pass through it. But if you interpose a sheet of conducting metal, such as aluminium, the waves are screened and the phenomenon stops.

5367

Cathode ray tube for magnetic deflection 5222

In this tube a white, fluorescent screen, appropriately inclined, allows you to visualise the deflection of a beam of electrons produced by a magnet. We suggest the use of the "U" shaped magnet code 5173 and operation is only guaranteed with the Ruhmkorff's coil code 5208. Two connecting leads (5013) and two alligator clips 5062N, 5062R are required. (not supplied).

5222

Cathode ray tube with whirl 5223

This tube enables you to show the mechanical effects of cathode rays. In fact a small, fluorescent whirl , which can rotate with little friction, starts spinning the moment the cathode ray beam hits it. Operation is only guaranteed with the Ruhmkorff's coil code 5208. Two connecting leads (5013) and two alligator clips 5062N, 5062R are required. (not supplied).

5223

Apparatus for the measurement of the e/m ratio 5304

The main part cosists of a hot cathode Thomson's tube, whose filament must be fed with a voltage of 6,3V ac and whose anode must be fed with a voltage of 1500-5000 V dc. The beam of electrons produced is deflected by an electric field produced by a generator of medium voltage and by magnetic field created by two Helmholtz reels. The measure of the electron specific charge can be determined with a percent mistake of 5% .

Topics

- Nature of the cathode rays
- Electric and magnetic deflection
- Evaluation of the ratio e/m with a grom percentage less than 5%

Separate purchase of generators is required to power the appliance code 5229 , 5324 and 5292. As an alternative to the alternator 5229 it is possible to purchase the 4991 power supply.

5304

Malta cross tube 5224

With this tube it is possible to prove that cathode rays spread in a straight line. A Malta cross- like metal screen can be placed to intercept the cathode ray beam, producing a shadow zone on the screen which satisfies the laws of rectilinear propagation. Operation is only guaranteed with the Ruhmkorff's coil code 5208. Dimension: 45x17x60 cm.

5224

Led light wavelength measurement kit 5392

The light emitted by a LED, is not monochromatic; it covers a small frequency band. If you want to measure Planck's constant with a LED , it is necessary to know this band medium frequency, which is easy to measure with this kit that exploits the diffraction grating.

Equipment supplied

1 Linear ruler
1 LED projector with power unit
1 Lens +10 with lens holder
1 Filter holder
1 Diffraction grating 500l/mm
1 Base for LED
3 Bases
1 White screen
1 Case

5392

Photoelectric effect 5435

Thanks to this apparatus you are allowed to study the photoelectric effect, retracing the fundamental steps that have underlined the unsuitableness of the classic mechanics and have introduced all these new concepts thanks to which the quantum mechanics was born.
The photoelectric effect or photoemission is the production of electrons or other free carriers when light is shone onto a material. Varying the voltage across the phototube, you will be able to check the relation between the energy of the emitted electrons and the wavelength of the incident radiation. Thanks to Einstein notion regarding photoelectric effect, you will also be able to estimate the value of the Planck constant. This instrument is a good starting point to study quantum mechanics. It is basically composed of two parts: a phototube and a control unit (in which is built-in a voltmeter and a nanoammeter). Three LEDs, with average wavelength known, are supplied.
The light intensity could be varied from 0 to 100%.

Technical data
Power supply: 24V DC
Voltmeter 4 digits, sensibility: <2mV
Ammeter 4 digits, sensibility < 5nA
Button to cut off current
LED light adjustment 0-100%
Anodic tension adjustment

Topics

- How to use it
- Historical notes on the nature of light
- Electromagnetic waves
- Intensity of electromagnetic waves
- Photoelectric effect
- Photoelectric cell
- Work function
- Threshold frequency
- Characteristic graphic of a photocell
- Stopping potential
- Kinetic energy of electrons doesn't depend on radiation intensity
- The number of emitted electrons depends on radiation intensity
- Summary
- Einstein quantum theory
- How Einstein quantum theory explains events
- How to value threshold frequency
- How to measure Planck constant

Equipment supplied

3 LEDs (green, red and blue)
1 Base with phototube
1 Unit control
1 Power supply 24 V DC

5435

Planck's constant measurement kit 5410

The measurement of Plack's constant can be obtained also exploiting the quantum properties of the LED diodes. If a LED diode is directly polarized, it starts emitting light the moment the potential energy produced by the electrons, is enough to make them pass from the conduction band to the valence band (Energy gap). As consequence of this energy gap , every electron emits one photon of energy

$$hf = eVs$$

If you know the potential Vs in correspondence of which the LED starts emitting a weak light , it is possible to go back to the value of h.
3 LED are supplied, red green and blue, in order to verify that the higher the energy gap is, the more intense the emitted light frequency becomes.

5410

Kit to study the solid state 5413

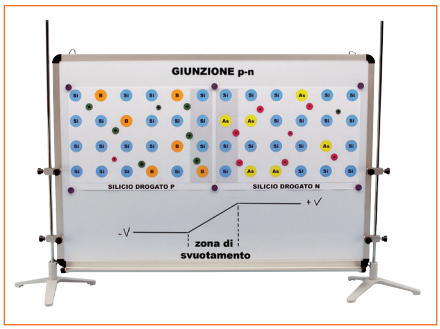
In 1948 when the american physicists h. Brattain, w. And j.Bardeen shockley discovered the transistor effect, the electronic technique has implemented an extraordinary evolution. This kit has been designed to make it easier for students to grasp concepts which are not very intuitive. It consists of a series of explanation charts to be applied on a magnetic board. The interactive feature of the kit allows the teacher to simulate some processes of interaction between photons and matter, showing the passages from a situation to the following one. For performing these experiences, you must have a magnetic whiteboard and a low voltage regulated power supply.
We recommend code 5360.

Topics

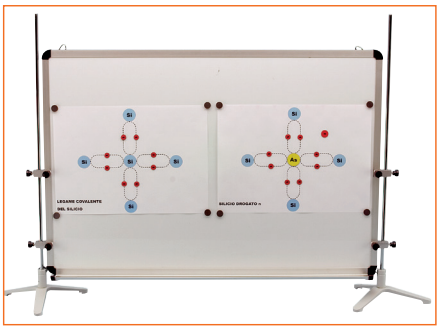
- Atomic energy levels
- The metals crystal lattice
- Energy bands
- Allowed bands and forbidden bands
- Insulators, conductors and semiconductors
- The Ohmic conductor
- The PTC thermistor
- The NTC thermistor
- The photoresistor
- Semiconductors doping
- The junction diode
- The Led
- How to measure the Planck's constant
- The reversibility of the Led
- The photovoltaic cell
- The solar panels

Equipment supplied

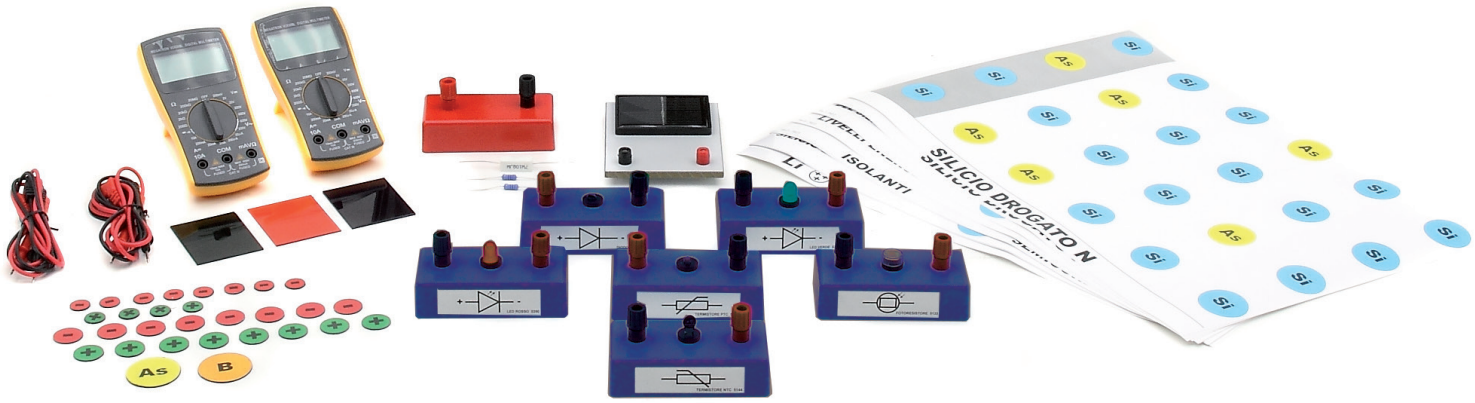
1 Red filter
1 Green filter
1 Purple/blue filter
1 Resistor holder base
1 Photoresistor on base
1 Thermoresistor NCT
1 Silicon Diode on base
2 Portable digital multimeters
1 Photovoltaic panel
1 PTC thermistor
1 Red led on base
1 Green led on base
1 Resistor 10 Ω 7W
1 Resistor 1 KΩ 2W
1 Resistor 100 Ω 2W
1 Set of 11 Tables
1 Small case for tables
1 Set of magnetic tokens
1 Box



Silicon N-doped



Silicon P-doped



5413